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ABSTRACT

An analysis of part-of-speech membership was made utilizing certain mechanisms that have been proposed to explain the nature of word classes. It was proposed that words of the same form class constitute "verbal habit families" on the basis of either a common grammatical meaning response, a common affix, or a common label (e.g., "verb"). One implication of this model was that sentences may be regarded as sequences of grammatical habit families. Three experiments tested two derivations from the model. Experiments one and two indicated that, under certain circumstances, words classified as verbs do indeed constitute a word response class. Experiment three tested the hypothesis that a novel word will gain verb properties by being paired with other verbs. The results of this experiment indicated that the greater the number of times a nonsense syllable was paired with verbs, the less often it was used as a verb in a sentence completion task. This result, contradictory to the hypothesis, did not appear incompatible with the model developed, but further research is needed for an adequate evaluation. (Author/LH)

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THE GRAMMATICAL FORM CLASS OF VERBS AND THE OPERANT CONDITIONING OF WORD CLASSES

Report from the
Motivated Learning Project

By Karl Alfred Minke, Jr.

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Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
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Activities are differentiated into three research and development Programs--1, Conditions and Processes of Learning; 2, Processes and Programs of instruction; and 3, Facilitative Environments--and support programs. This (type of publication) is from Project Motivated Learning in Program 1. General objectives of the Program are to generate new knowledge about concept learning and cognitive skills, to synthesize existing knowledge, and to develop educational materials suggested by the prior activities. Contributing to these Program objectives, this project aims at extending and learning theory in the context of complex human behavior, and applying the theory in developing procedures to solve problems of human learning.

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ABSTRACT

Current theories relating to grammatical form classes were critically discussed in terms of the degree to which they could handle two common phenomena: (1) syntactic generalization, and (2) the syntagmatic-paradigmatic shift. Recent S-R theories were found to best explain the phenomena, but it was suggested that a still more satisfactory analysis should minimize the number of associations that theoretically must be acquired before a new word can be used correctly in a sentence and must overcome "reaction time" criticisms of S-R models of sentence generation.

Based upon several sources of evidence indicating that grammatical form classes also constitute word response classes in the operant sense, an analysis of part-of-speech membership was made utilizing certain mechanisms that have been proposed to explain the nature of word classes. Specifically, it was proposed that words of the same form class constitute _verbal habit families_ on the basis of either a common grammatical meaning response, a common affix, or a common label (e.g., "verb"). One implication of the model was that sentences may be regarded as sequences of grammatical habit families.

Three experiments tested two derivations from the model. Experiments 1 and 2 indicated that under certain circumstances words classified as verbs do indeed constitute a word response class. Experiment

3 tested the hypothesis that a novel word will gain verb properties by being paired with other verbs. The results of this experiment indicated that the greater the number of times a nonsense syllable was paired with verbs, the less often it was used as a verb in a sentence completion task. While this finding was in contradiction to the hypothesis, an ad hoc analysis suggested that it was not incompatible with the model developed. It was concluded that the model was not completely validated by the experiments conducted and that further research is required for an adequate evaluation.

I

INTRODUCTION

It has been suggested (Ervin-Tripp & Slobin, 1966) that one of the important tasks of a theory of language behavior is to account for the production of novel speech. In the area of psycholinguistics two competing theoretical approaches have been applied to this problem.

Chomsky (1965), working from the rationalist tradition, has proposed the system of generative grammar to describe and explain language behavior. According to Chomsky, the general form of linguistic knowledge is an innate characteristic, a mental disposition that is realized as a function of experience. A generative grammar is a system of characterizing the "knowledge of the language that provides the basis for actual use of language by a speaker-hearer" (p.9). Specifically, Chomsky defines a generative grammar as a set of rules operating upon an inherent basic structure to generate an infinitely large number of permissable utterances. Language learning involves the child "constructing" this grammar by analyzing the utterances to which he is exposed, making use of an "innate linguistic theory" consisting of inherent principles of analysis and certain types of innate language information.

The second major theoretical approach to the fact that humans can produce sentences and utterances to which they have never before been exposed is behavioral learning theory. Opposed to the rationalist tradition of Chomsky, stimulus-response (S-R) analyses of language behavior have proceeded from the empiricist tradition. The empiricist tradition holds that the structure of knowledge is independent of any innate capabilities and is the result of learning; the "givens" in this approach consist of the mechanisms whereby learning takes place To the S-R theorist these mechanisms are the principles of association, i.e., the principles of respondent and/or operant conditioning. S-R models of sentence generation are based upon sequential associations (either direct or mediated) among the words comprising the sentence, and novelty in sentence generation is typically regarded as some form of stimulus generalization. Language learning consists of the development of these associations through the operation of the appropriate principles of conditioning.

These two approaches to the development of a science of language behavior may be regarded as "competing paradigms," a term put forth by Kuhn (1962) in an analysis of change in scientific theory and methodology. According to Kuhn, a paradigm is a conception of law, theory, and methodology which is shared by members of a scientific community. Research under a particular paradigm is referred to as "normative science," and is likened to puzzle-solving endeavors. A number of assumptions are dictated by the paradigm, and normative research is basically concerned with forcing nature into the preconceived framework.

Periodically, however, competing paradigms come into existence, challenging the original paradigm. It is the resolution of this conflict which brings about scientific change. Kuhn points out that this resolution cannot take place on purely logical grounds; the rules and assumptions under which the two paradigms operate are different, the problems seen as critical are different, and each group has its own view of the nature of the world. Communication between the members of the opposing paradigms is difficult, since they assign different meaning to the basic concepts of the science. Thus, "critical experiments" or definitive arguments designed to validate one paradigm over the other are virtually impossible. Katahn and Koplin (1968) suggest that since argument cannot decide which paradigm in a paradigm clash will be more fruitful, and since argument is frequently based upon premises rejected or considered irrelevant by the opposing position, the most fruitful approach in the face of such conflict is that of attempting to develop each paradigm more fully, i.e., to continue normative science activities. In other words, the individual scientist, when faced with a paradigm clash, will make a greater contribution to the ultimate resolution of the conflict through the further elaboration of his own paradigm than he would through attempting to attack the opposing theoretical conception.

This represents the strategy underlying the present paper. The theoretical model and research to be reported are viewed as an extension of the general S-R paradigm to certain complex issues involved in sentence generation, specifically, the nature and operation of grammatical form classes or parts of speech. In the next chapter both grammatical form classes and word response classes will be discussed in terms of the operational manipulations defining such classes and in terms of the major explanatory concepts that have been proposed to account for their existence. In Chapter III a new S-R analysis of part-of-speech membership will be developed, in which it is suggested that words classified as belonging to the same grammatical form class will also demonstrate word class properties in the operant sense and that the mechanisms accounting for word response classes can be extended to grammatical classes as well. In Chapter IV three experiments will be presented testing certain of the consequences of the theoretical model developed in Chapter III, and in the final chapter the results of these experiments will be discussed with respect to this model.

II

FORM CLASSES AND WORD RESPONSE CLASSES: DEFINITION AND THEORY

The Grammatical Form Class

Traditionally, the concept of a particular part of speech has been discussed in terms of some general meaning common to the various words making up the category. For example, a noun is frequently defined as "a name of a person, place, or thing." It has been noted, however (Fries, 1952), that such a definition does not allow one to exclude from a particular part-of-speech class a number of words that in reality are classified as being members of other parts of speech. For example, the definition applies to the word red (i.e., red is the name of a color), yet red usually functions in English as an adjective.

Fries (1952) attempted an analysis of the concept of part of speech in English in terms of the attributes of words comprising the various grammatical categories. He pointed out that the meaning conveyed by a sentence is of two kinds: (1) the meaning conveyed by the various independent words of which the sentence is composed and (2) the structural meaning conveyed by the sentence. For example, the sentence The man gave the boy the money conveys, over and above the meanings of the individual words man, gave, boy, money, etc., the fact that the man was the initiator of the action, the boy was the recipient, the action has already taken place, and so on. According to Fries, it is the devices that signal the structural meanings which constitute the grammar of the language.

The first step in Fries' attempt to isolate the devices which signal structural meaning involved the use of free utterance test frames, or sentence frames. These sentence frames were based upon three sentences: (1) "The concert was good (always);" (2) "The clerk remembered the tax (suddenly);" and (3) "The team went there." The basic procedure was to group together all words which could be substituted for each other at each point in each of these three sentences without changing the structural meaning of the sentence. For example, all words which can occur in the following positions in the test frames are called Class 1 words: "The _____ was good (always);" "The _____ remembered the _____ (suddenly);" and "The _____ went there." By attempting substitutions at the various positions in these three sentences, Fries identified five basic classes of words: Class 1 words, which generally correspond to nouns; Class 2 words, corresponding to verbs; Class 3 words, or adjectives; Class 4 words, adverbs; and a fifth group, consisting of all remaining words, which are called _function_ words. Words of this last class have at least two unique features: (1) although there are only approximately 150 of them, these words constitute approximately one third of the total words used; and (2) these words, for all practical purposes, have no meaning of their own separate from the structural meaning which they signal.

Berko and Brown (1961) applied the term form class to language forms which can be grouped into a class of functionally equivalent units. By definition, members of a common form class share similar "privileges of occurrence" in the sentence. Thus, words sharing common part-of-speech membership, at least according to Fries' operational definition, also would be members of a common form class.

Although Fries identified his grammatical form classes on the basis of only three sentences, the generalization that these classes constitute general behavioral categories is evident from the fact that words which share common "privileges of occurrence" in one frame will do so to a large extent in other frames as well. Further, words learned in one context can immediately be used correctly in a number of other contexts (Brown & Berko, 1960). This phenomenon will be called "syntactic generalization" throughout the remainder of this paper.

Additional evidence for the "psychological reality of syntactic categories" (Miller, 1962) comes from word association data. It has been found (Brown & Berko, 1960; Ervin, 1961) that young children tend to respond in a free-association situation with a word of a different grammatical class than the stimulus word, while older children and adults tend to respond with members of like classes. These types of associations have been called "syntagmatic" and "paradigmatic," respectively (Ervin, 1961). Deese (1962) found that with adult subjects nouns yield noun associates 79% of the time, adjectives elicit other adjectives 50% of the time, verbs elicit verbs 52% of the time, and adverbs yield adverbs 27% of the time.

Theoretical statements concerning the nature of grammatical form classes have attempted to explain one or both of the above phenomena, i.e., syntactic generalization and the syntagmatic-paradigmatic shift. Fries (1952), addressing himself to the first phenomenon, suggested that the language user responded to "distinctive features" or attributes or, in behavioral terminology, discriminative stimuli, which serve as signals for structural meaning. Fries identified such distinctive features as (1) differences in affixes associated with the same root words (e.g., befriend in Class 2 corresponds to friend in Class 1, enrage corresponds to rage, beautify corresponds to beauty, etc.); (2) differences in affixes associated with different environmental circumstances (e.g., the dental suffix /t/ or /d/ on a Class 2 word correlated with past action); and (3) differences in affixes associated with distinctive features of words occupying other positions in the same sentence (e.g., the sibilant ending /s/ on a Class 1 word in the first position of the test frame correlated with the absence of such an ending on a Class 2 word occurring in the second position, such as "Boys play_"). The most important distinctive feature identified consisted of the position occupied by a given word in the sentence in which it occurs. Fries suggested that words comprising a common form class operate as a behavioral category because of certain formal characteristics shared with other members of the class. A novel word would become a member of the appropriate form class by having the appropriate affix attached to it or by being used in the appropriate position in the sentence.

Brown and Berko (1960) emphasized the positional and contextual cues in their analysis of grammatical form classes. They suggest that words resemble one another syntactically to the degree that they have similar privileges of occurrence. Although this syntactic similarity is always objectively present in ongoing speech, the ability to analyze this similarity and utilize grammatical form classes in the production of sentences that are not mere imitations of sentences, overheard from someone else, is a slow developmental process, dependent upon experience with words comprising the various parts of speech. Brown and Berko regard the syntagmatic-paradigmatic shift phenomenon as a manifestation of the development of this ability to recognize identical privileges of occurrence and have demonstrated that the syntagmatic-paradigmatic shift parallels the ability to use novel words in a grammatically correct manner when they are initially presented in sentences.

It is suggested that neither of the above analyses provide an adequate explanation for the operation of grammatical form classes. While Fries provided a detailed description of the physical properties of words belonging to the same form class, he failed to specify the mechanisms whereby these stimulus features are related to the behavior of the language user. Further, in light of the syntagmatic-paradigmatic shift phenomenon, his analysis would seem somewhat limited. That is, Fries' analysis would appear to have difficulty explaining the class properties of words of a common form class when they occur independently of the sentence and with minimal distinctive features present, as in word association tests. Another example of this type of situation will be found in the first two experiments presented in Chapter IV.

The position of Brown and Berko can be summarized as follows: Experience with parts of speech leads (eventually) to the "recognition of syntactic similarity" which, in turn, leads both to paradigmatic responses in free-association tests and to the ability to use a word initially presented in one context in all other contexts appropriate to that form class. The phrase "recognition of syntactic similarity" apparently is used as a descriptive device referring to certain unspecified cognitive or psychological events which result in orderly relations between experience and certain types of verbal behavior. It would appear that the type of experience required for the development of syntactic recognition and the nature and operation of this cognitive event should be specified in order to better understand the form class phenomena.

S-R analyses of grammatical form classes attempt to overcome some of the above objections by specifying the nature of the associations between the stimulus features of the language and the individual's verbal responses. Further, the nature of the learning experience is emphasized. One of the earliest such analyses was proposed by Miller (1951), who suggested that the development of word order was a form of word association learning. That is, one word follows another in spoken langauge because, in language learning, the child had been exposed to those words in that order. Thus, words having similar "privileges of occurrence" would be words that had come to be elicited by the same preceding words and that had tendencies to elicit the same subsequent words.

Several serious problems are posed by this simplistic model (which has since been rejected by Miller himself). First, the number of associations necessary to account for the complexities of adult speech are astronomical (Miller & Chomsky, 1963). Miller (1965) stated, "Since the variety of admissable word combinations is so great, no child could learn them all" (p.18). Second, such an analysis had difficulty explaining syntactic generalization phenomena, in which a new word is learned in one sentence context and then immediately is used correctly in a number of other sentences. Finally, such an analysis handles syntagmatic word associates quite nicely, but fails to account for paradigmatic associations. Thus, the word deep is very likely to elicit the response HOLE from a young child because deep had been followed by hole many times in the child's verbal environment. The basis of the association between deep and shallow (the most likely response with adults), however, is not so readily discernible.

Ervin (1961) has proposed an S-R analysis designed to deal specifically with the syntagmatic-paradigmatic shift phenomenon. This analysis is based upon direct associations among words of the same form class. Ervin suggested that the syntagmatic-paradigmatic shift in word associations may be due to associations developing among words of the same form class through a process of "incorrect anticipations." It is suggested that a person listening to another speaker "anticipates," or covertly verbalizes, later words in an ongoing sentence and that these anticipations are sometimes incorrect. When this happens, an association is established between the word emitted overtly by the speaker and the word emitted covertly by the listener.

McNeill (1966) attempted a direct test of Ervin's "incorrect anticipation" hypothesis. The Ss were orally presented a set of sentences with one of four nonsense words occupying an adjectival position and one of two nonsense words associated with each adjective occurring in a noun position. The sentences used on each trial were all different, and the two nouns in each triad of nonsense words were each used 50% of the time. The Ss were told that the experiment was concerned with learning which nonsense words occurred together in the same sentence. Experimental group Ss were further instructed to overtly anticipate the noun word in each sentence. Since there existed two possible noun nonsense words for each adjective, the conditions for the formation of both syntagmatic and paradigmatic associations were present. McNeill hypothesized that Ss under deliberate instructions to anticipate should develop more paradigmatic associations than Ss with no such instructions. The results failed to confirm this hypothesis, and he concluded that paradigmatic associations were not acquired by experiencing words in contiguity. It should be noted, however, that this experiment cannot be taken as definite evidence that the "incorrect anticipation" hypothesis is invalid. McNeill's experiment is based upon the assumption that implicit anticipations will occur less frequently than overt anticipations, which may or may not be true.

Opposed to Ervin's analysis, which is based upon direct associations among words of the same form class, Jenkins and Palermo (1964) proposed a mediation model of grammatical form classes which suggests that mediation paradigms as studied in paired-associate learning occur naturally in the speech community of the child. Of particular importance to the understanding of grammatical form classes are the so-called "stimulus equivalence" and "response equivalence" paradigms (Jenkins, 1963). In the first case, learning C-B and A-B associations results in the establishment of a bidirectional association between the A and the C terms through the mediation of the common B associate, i.e., the A and the C terms become "similar," or functionally equivalent. Any stimulus which tends to elicit A will also tend to elicit C, and any response conditioned to A will tend to occur to C as well. Similarly, in the response equivalence paradigm learning A-C and A-B associations results in establishing a bidirectional association between B and C. Thus, Jenkins and Palermo suggest that hearing the sentences _John is jolly_ and _Christmas is jolly_ results in placing _John_ and _Christmas_ in the same class through the mediation of the common phrase _is jolly_ (stimulus equivalence). Similarly, hearing the sentences _John is pleasant_ and _John is jolly_ results in _pleasant_ and _jolly_ becoming members of the same class mediated by the common phrase _John is_ (response equivalence).

It should be noted that backward associations are assumed to be formed in the stimulus-equivalence and the response-equivalence paradigms. Some S-R theorists (e.g., Staats & Staats, 1963; Staats, 1968) would probably object to the necessity of assuming that backward conditioning can take place, but this seems to be a well-established phenomenon in verbal learning. The fact that backward conditioning may be an artifact due to covert rehearsal behaviors would not seem to be a serious drawback when dealing with verbal behavior in naturalistic settings.

Staats (1968) has combined the major features of the above three analyses in his discussion of grammatical phenomena. He suggests that the sentence may be regarded as a sequence of verbal response hierarchies, both convergent, where various verbal stimuli come to elicit the same word, and divergent, where the stimulus properties of a single verbal response come to elicit various words. Once a new word has come to be elicited by a word already in the individual's repertoire, then any sentence containing the previously learned word will have a probability of including the newly acquired word as well. For example, once the child has heard the sentence This is a car, an association is formed between the word a and the word car; the word car can now occur in any sentence that the child is capable of producing which contains the a. Further, the word a should be associated with such words as the and this through the implicit elicitation of all three words by such stimuli as own, see, what, etc. Thus, any sentence containing the words the or this would also be capable of including the new word car, mediated by the original stimulus a. Staats suggests that this analysis greatly reduces the number of associations that must be learned directly by the child and can explain syntactic generalization on the basis of mediational mechanisms. His analysis of the development of associations among the words a, the, and this suggests that he probably would accept Ervin's "incorrect anticipation" hypothesis as an explanation for paradigmatic associations, although he does not deal directly with this phenomenon himself.

It is doubtful that any of the above analyses have successfully solved the problem raised by Miller (1965) and Miller and Chomsky (1963) in discussing word association models, i.e., the huge number of paired associates required to account for the complexities of adult speech. Further, word association norms (e.g., Russell & Jenkins, 1954) do not indicate the complex associations necessary to account for the complexities of novel sentence generation. Finally, Lashley (1951) has suggested that language behavior proceeds at such a rapid rate that analyses based upon associations between successive words is at variance with what is known about reaction time. It would seem that this objection is particularly relevant to those analyses which include verbal mediation paradigms--those models which seem best able to account for the syntactic generalization phenomenon.

Braine (1963, 1965) recognized the inadequacies of a model of sentence structure based upon associations among the individual words and suggested that another mechanism is operative as well, i.e., associations between words and phrases and the relative temporal position cues in the sentence. Generalization based upon this mechanism is called "contextual generalization."

> . . . when a subject, who has experienced sentences in which a segment (morpheme, word, or phrase) occurs in a certain position and context, later tends to place this segment in the same position in other contexts, the context of the segment will be said to have generalized, and the subject to have shown contextual generalization (1963, p. 323).

Contextual generalization, then, is a limiting case of what has been termed "syntactic generalization" in this paper. Contextual generalization required that the positional cues remain constant, while no such limitation is imposed upon syntactic generalization.

Braine (1963) demonstrated the contextual generalization phenomenon by first teaching an artifical language to 9 and 10 year olds. In this language sentences were two words long. In the initial training either of two words could occur in the first position (A words) and either of two words could occur in the second position (P words). Once Ss had learned all four possible sentences in this language by means of a sentence completion task, Braine presented a generalization test. In this test a new A or P word was given and the alternatives in the sentence completion task consisted of one A word and one P word presented in the initial learning. Four such problems were presented. On this task 78% of the problems were solved by Ss filling in the blank with the word that had occupied that position in the initial learning.

This analysis overcomes the major criticisms of word association analyses. Each word, to become a member of a given grammatical form class, need only be paired with a finite number of positional stimuli, rather than with all possible words with which it may later occur in conjunction. Further, this analysis overcomes the temporal objections raised by Lashley in that complex generalization phenomena are based upon a direct association between the word and the positional cues rather than upon mediation by means of one or more words. However, this analysis is still deficient in terms of handling all of the complex forms of syntactic generalization, and it offers no insight into the nature of paradigmatic word associations. Braine suggests that such associations are to be explained by the mediation model of Jenkins and Palermo.

In summary, it is suggested that a theory of the nature of grammatical form classes must explain two phenomena: syntactic generalization and the existence of paradigmatic associations. Such a theory should relate the stimulus features of language to the behavior of the speaker and should specify the nature of the learning experience resulting in the formation of such classes. For such a theory to be plausible, it needs to minimize the number of associations that must be formed in the language learning of the child, and it must minimize the response time of any inferred mediational mechanisms. In Chapter III it will be suggested that words comprising a common grammatical form class have yet another characteristic which must be explained by such a theory—they will operantly condition as a word response class.

The Word Response Class

A word response class is a group of words having the characteristic that reinforcing some of the words in the class makes all other members of the class more probable (even though they themselves have never been followed by reinforcement in the experimental situation). The classic experiment in this area was performed by Greenspoon (1955). The Ss were instructed to emit words, one at a time and were reinforced by *E* saying "mmm-hmm" each time a plural noun was emitted. It was found that under this procedure *S*s emmitted more and more plural nouns across time. Verplanck and associates (Verplanck, 1956; Wilson and Verplanck, 1956) replicated Greenspoon's experiment, demonstrating that a wide variety of word response classes could be identified under this procedure, e.g., travel words, living things words, etc.

The above procedure is a direct application of free operant techniques to verbal behavior. Both the rate and the content of the verbal behavior are under *S*s' control. In contrast, a controlled operant procedure was developed by Taffel (1955), in which *S*s were shown cards, one at a time, containing a verb in the past tense and six pronouns. The *S*s were instructed to compose sentences using the verb and one of the six pronouns. Each time *S* utilized the pronouns *I* or *we* he was reinforced, resulting in an increase in the frequency of two-word sentences utilizing first-person pronouns.

Since these early studies a number of experiments have been performed using one or the other paradigm and manipulating such variables as type of subject, response class, reinforcement, etc. (See Greenspoon, 1962; Krasner, 1958; Salzinger, 1959.) At first, the implications of these studies were seen to lie mainly in the area of clinical interviewing, demonstrating in a direct fashion that a patient's verbal behavior was at least partially under the control of subtle cues emitted by the therapist. Later, however, it became apparent that the operant conditioning of word response classes raised a number of theoretical questions in its own right (Kanfer, 1968). Of particular importance was the nature of the relationship among the words comprising such a class. With many of these response classes, as opposed to non-verbal response classes in lower animals, there was not any common physical dimension along which the responses varied except the obvious one of vocal emission. The differences among the individual responses were qualitative rather than quantitiative.

Attempts to handle this problem have been of two major types: Salzinger (1959) offered a non-mediational descriptive analysis, while both Dulany (1961, 1962) and Staats (1961, 1963) postulated mediational mechanisms to account for the phenomenon, the former in terms of cognitive hypotheses and the latter in terms of implicit S-R associations.

Salzinger (1959) has suggested that words may be identified as members of a common class if it can be shown that they (1) may be substituted for one another; (2) are followed by the same reinforcement; or (3) are emitted in the presence of the same discriminative stimulus. It is interesting to note that the first criterion parallels the definition of a grammatical form class and that the last two are basically restatements of the stimulus equivalence and response equivalence paradigms proposed by Jenkins and Palermo (1964) to explain associations among members of the same form class.

Staats (1961) criticized Salzinger's analysis by pointing out that many word response classes are made up of words which are not functionally equivalent; that most words are followed by the same reinforcer, regardless of the specific words classes of which they are a member; and that words which are emitted in the presence of specific discriminative stimuli will still condition as a word response class. Also, many word response classes contain members which are classified as belonging to different parts of speech-substitution in a sentence of one word in the class for another could well make the sentence meaningless. Further, as Skinner (1957) has pointed out, most words in ongoing speech are reinforced by the same generalized reinforcers regardless of the referent, i.e., other words. Finally, words in many response classes are *tacts* or labels to a variety of very specific and very distinctive environmental objects and events.

Dulany (1961) suggested that the word response class phenomenon is dependent upon *S*s being "aware" of the stimulus-response contingencies, i.e., upon their ability to verbalize both the nature of the correct response class and the reinforcing stimuli. He presented data showing conditioning does not take place unless *S*s reported the correct reinforcement contingencies and that the degree of conditioning in a word response class experiment was correlated with the degree to which *S*s could verbalize "awareness" of the experimental situation. Awareness in these experiments is measured by *S*s' postexperimental reports. On the basis of these reports Dulany (1962) postulated the following constructs: (1) *reinforcement hypotheses*, guesses as to the nature of the subsequent feedback; (2) *behavioral hypotheses*, guesses as to the correct response class; and (3) *behavioral intentions*, *S*s' reported intention to perform or not perform the correct response. Reinforcement is assumed to operate by confirming or disconfirming these hypotheses.

Dulany's position has been challenged on a number of methodological grounds (Kanfer, 1968; Spielberger & DeNike, 1966). The major criticisms involve (1) the use of Ss' postlearning reports to infer processes which mediate that learning, and (2) the assumption that a one-to-one correspondence exists between the verbal reports and the events they supposedly index. Dulany has dismissed numerous studies purporting to show conditioning of word response classes without "awareness" by stating that their authors did not use appropriate procedures for assessing it. However, demonstrations that covert responses too minute to be sensed by the Ss can be manipulated through reinforcement (e.g., Hefferline, Keenan, and Harford, 1959) and that verbal "hypotheses" and subsequent performance can be manipulated independently (e.g., Verplanck, 1962) are cited by Dulany's critics as strong evidence that human learning is not necessarily dependent upon the implicit hypothesis behavior of the S.

Those objecting to Dulany's postion argue that while such verbal statements can mediate performance in verbal learning experiments, it is not necessary that they do so. In experiments designed to investigate the associative bases of a given word class awareness is usually controlled by eliminating Ss who can verbalize the correct contingencies following the conditioning procedure and by making the situation so complex that the likelihood of Ss being able to label the experimental variables is minimized.

The most complete S-R analysis of variables accounting for word response class properties is that set forth by Staats (1961, 1963, 1968) and experimentally verified by Staats and his associates (Staats, Staats, and Finley, 1966; Staats, Staats, Finley, and Minke, 1961; Staats, Staats, & Minke, 1966), based upon the conditioning of common implicit responses to situational stimuli. Briefly, it was demonstrated that words which (1) are members of a verbal chain of responses, (2) are interassociates of each other, or (3) are members of the same verbal habit family will operantly condition as a word response class.

In discussing the operation of a serial chain of word associates as a word response class, Staats (1963, 1968) suggested that when the first response in such a chain is emitted in the experimental situation, the next few responses in the chain also are emitted, albeit implicitly. Thus, reinforcement contingent upon the first response also strengthens the subsequent responses to the contextual cues. If the second response in the chain also is overtly emitted and reinforced, the probability that the third response will be emitted is increased still further. ". . . Each succeeding word response in the sequence, when it occurred [and was reinforced], would further increase the likelihood that the next response would be elicited" (1968, p. 151). This process is diagrammed in Figure 1 for a verbal chain well established in people educated in the United States, the Pledge of Allegiance. It should be noted that words so associated would be expected to operate as a word response class even though they were not emitted in serial order in the experimental situation, since associations would exist

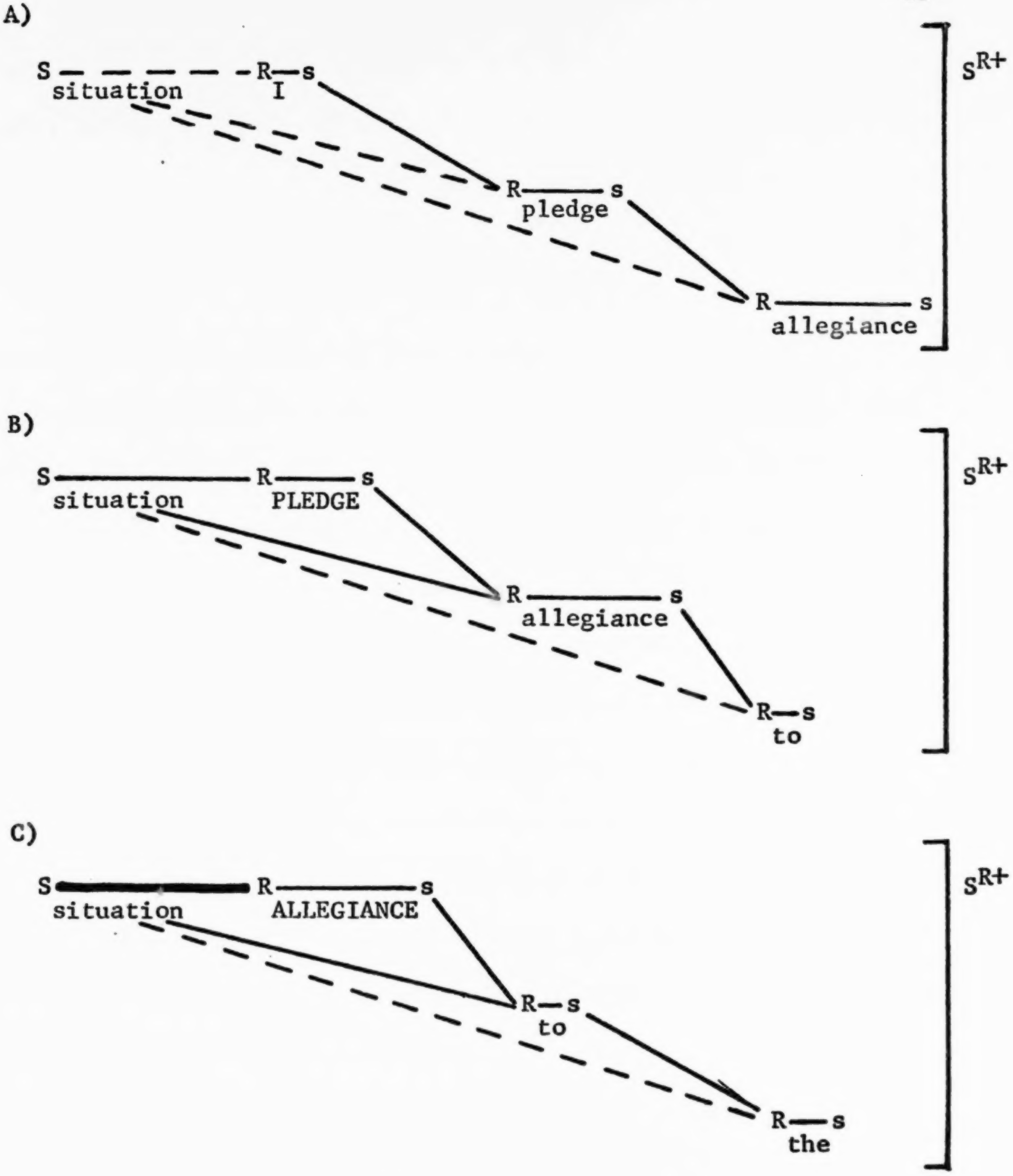
A)
S
situation
R
I
s
R
pledge
s
R
allegiance
s
S^{R+}
B)
S
situation
R
PLEDGE
s
R
allegiance
s
R
to
s
S^{R+}
C)
S
situation
R
ALLEGIANCE
s
R
to
s
R
the
s
S^{R+}

Figure 1. The Pledge of Allegiance as a word response class. (A) When the first response (I) of the serial chain is emitted and reinforced, not only is this particular response strengthened in the presence of the situational stimuli, but the next few responses (pledge, allegiance), elicited implicitly, are strengthened as well. (B) If the second response (PLEDGE) is also emitted and reinforced, the third response (ALLEGIANCE) is strengthened still further. (C) Each succeeding response that is emitted and reinforced further increases the probability that the next response in the chain will also be emitted. (Adapted from Staats, Staats, Finley, & Minke, 1961.)

among the words in the chain even though they were not directly contiguous. However, the closer the order of emission of the individual words to the original serial order, the stronger should be the associations among the succeeding words and the stronger should be the word class phenomenon.

The above analysis suggests that any group of interassociated words should operantly condition as a word response class. Reinforcing one word in such a group should also increase the probability of occurrence of other words elicited implicitly, both those that are directly elicited by the reinforced word and those that are mediated by those direct associates. Thus, words which are complex interassoicates of each other should also constitute a response class.

The third mechanism whereby words can become members of a common response class, the verbal habit family, will be discussed in the next chapter in which it will be suggested that words sharing common part-of-speech membership are also members of common habit families based upon implicit grammatical "meaning responses."

III

VERBS AS MEMBERS OF A COMMON HABIT FAMILY

Several sources of evidence indicate that grammatical _form classes_ will condition as word response classes. As indicated in the last chapter, Salzinger's (1959) criteria for identifying words which will condition as a class include the operational definition of form classes as well as the mediation paradigms suggested by Jenkins and Palermo (1964) to account for the existence of such classes. Further, several experimenters have conditioned sub-sets of grammatical form classes. As mentioned earlier, Greenspoon (1955) conditioned plural nouns, and Wilson and Verplanck (1956) apparently increased the frequency of at least a sub-set of adverbs using Greenspoon's free-operant procedure. Using a controlled operant procedure very similar to that devised by Taffel (1955), in which responses making up the class were supplied by _E_, Binder, McConnell, and Sjoholm (1957) strengthened hostile verbs over non-hostile verbs, and Sarason (1957) conditioned verbs dealing with vocal speech.

It was suggested in Chapter II that a group of words would operantly condition as a class if they are (1) members of a verbal chain of responses; (2) interassociates of each other; or (3) members of the same verbal habit family. The discussion of these three mechanisms with respect to parts of speech will be restricted mainly to one grammatical form class, Class 2 words or verbs, although it is suggested that the analysis developed herein may be extended to the other three form classes as well. In terms of a response class of verbs, the first possibility, that verbs are members of a verbal chain of responses, seems unlikely. In everyday situations, individuals do not emit verbs in a serial manner nor do children learn verbs in serial order in normal language development. That verbs gain their word-class properties by becoming complex interassociates of one another would appear to be a more reasonable suggestion. Such a view would be congruent with several of the analyses of grammatical form classes presented in the previous chapter (i.e., the Ervin analysis based upon associations developing among members of the same form class through incorrect anticipations, and the Staats analysis, which makes use of a similar mechanism). As discussed in the previous chapter, however, several sources of evidence negate such an explanation. McNeill (1966) failed to find supportive evidence for the operation of "incorrect anticipations" in the formation of paradigmatic associations; and word association norms (e.g., Russell & Jenkins, 1954) show that only certain sub-classes of verbs are interassociated in the complex manner necessary to account for word class properties. For instance, the verbs _eat_, _dream_, and _sleep_ are all interassociates of each other and as such should be members of the same response class. However, the norms do not reflect the great number of associations that would be required in order for verbs in general to constitute a response class on this basis.

The "Verb" Habit Family

The third possibility suggested by the Staats analysis is that verbs are members of a common habit family. Staats (1961) extended the Hullian concept of the habit family to include certain aspects of complex human verbal behavior: in particular, concept formation and word response classes. Basically, a verbal habit family is said to exist when some stimulus elicits an anticipatory response which in turn, elicits a divergent hierarchy of verbal responses. These verbal responses, in turn, each elicit the common anticipatory response again. A habit family of verbs is diagrammed in Figure 2.

The operant conditioning of a response class consisting of members of a verbal habit family would thus be explained in the following manner. Each time a word in the habit family is emitted, it is followed by reinforcement. The reinforcement strengthens not only the particular verbal response emitted, but also the common anticipatory response. After a number of words belonging to the same habit family have been reinforced in the same stimulus situation, it would be expected that the situation would tend to elicit strongly the common anticipatory response, thus making all of the members of the habit family more probable in the situation. This analysis applied to the habit family presented in the previous figure is diagrammed in Figure 3.

The Nature of the Common Response Component: Grammatical Meaning. Following Cofer and Foley (1942), Mowrer (1954), and Osgood (1953), all of whom discuss word meaning as an implicit mediating response, Staats (1961) defined the verbal habit family in terms of a common anticipatory meaning response component. This meaning response com-

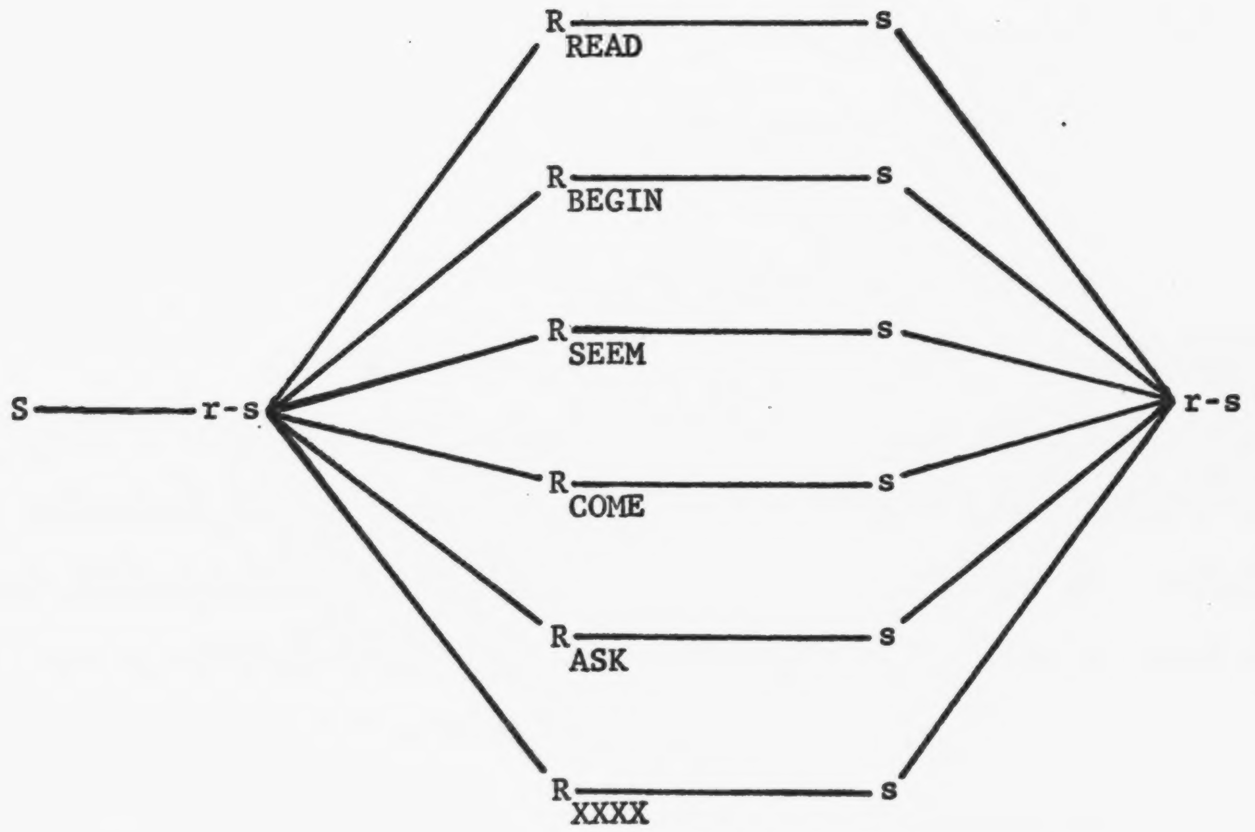
S
r-s
R READ
R BEGIN
R SEEM
R COME
R ASK
R XXXX
s
s
s
s
s
s
r-s

Figure 2. The "verb" habit family. Some stimulus (S) elicits an anticipatory response (r-s), which in turn elicits a class of verbs, the stimulus properties of which again elicit the common anticipatory response. (Adapted from Staats, 1961.)

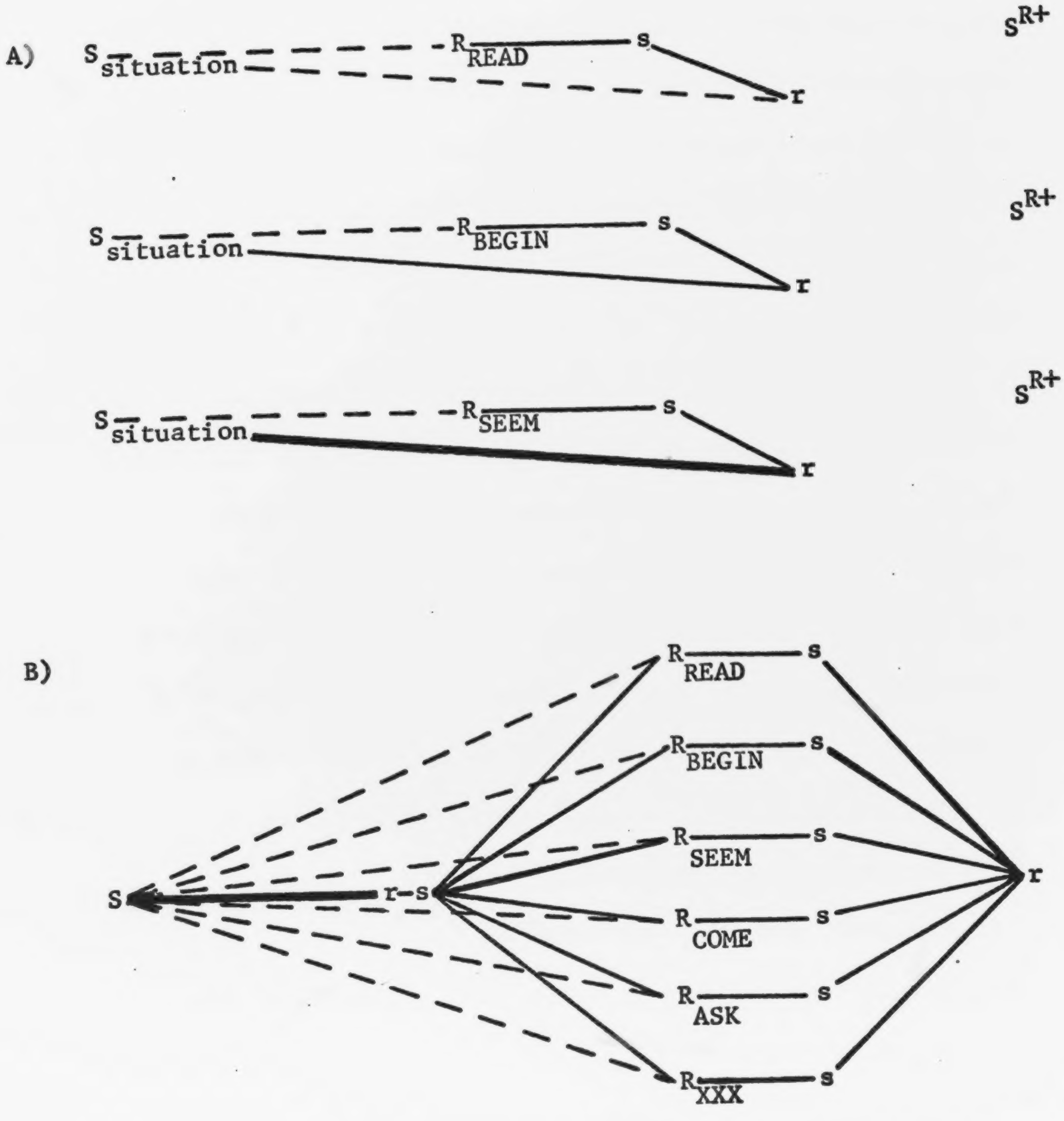
A)
S situation
R READ
s
r
S^{R+}
S situation
R BEGIN
s
r
S^{R+}
S situation
R SEEM
s
r
S^{R+}
B)
S
r-s
R READ
R BEGIN
R SEEM
R COME
R ASK
R XXX
s
s
s
s
s
s
r

Figure 3. The "verb" habit family as a response class. Each time a word in the habit family of verbs is emitted and followed by reinforcement (S^{R+}), not only the particular verbal response emitted, but also the common anticipatory response (r-s) is strengthened in the situation. After a number of such trials, the situation elicits strongly the anticipatory response which, in turn, mediates all the response members of the verbal habit family. (Adapted from Staats, Staats, Finley, & Minke, 1961.)

ponent corresponds, in general, to the Hullian concept of the fractional anticipatory goal response in that it is a portion of the total response to a stimulus object which is "detachable," i.e., it may be conditioned to other stimuli. Further, such responses are examples of "pure stimulus acts" (Hull, 1930) and, as such, are assumed to become reduced in magnitude as much as possible without losing their distinctive cue function.

The method by which a word gains its meaning may be summarized in the following manner. When a word is paired a number of times with the same or similar stimulus objects, a common detachable portion of the total responses made to these objects becomes conditioned to the word and constitutes its meaning. Staats (1961) illustrates this process by discussing the development of the meaning of the word _ball_. A mother holds up a ball in the presence of her child and says BALL. The object ball elicits a total response in the child, a portion of which may be conditioned to other stimuli. Thus, after a number of such pairings, the word _ball_ should elicit a portion of the total response made to the object ball. This conditioned response constitutes the meaning of the word _ball_.

For a word to be a member of a habit family, however, not only must the word elicit the meaning response, but the stimulus properties of the meaning response must elicit the word as well. Staats suggests that this takes place through the process of _tacting_. A _tact_ is defined as a ". . . verbal operant in which a response of given form is evoked . . . by a particular object or event or property of an object or event" (Skinner, 1957, pp. 81-82). Tacts, then, are verbal responses under the discriminative control of environmental stimuli. Staats suggests that tacting training results not only in the conditioning of the word to the environmental stimuli, but to the stimulus properties of the meaning response to that word as well. The verbal response to the stimulus object is reinforced in the presence of that object; however, since the stimulus object elicits sensory responses in the individual, the stimulus properties of these sensory responses also come to elicit the verbal response. Thus, when the child emits the response BALL in the presence of the object ball, not only is the word strengthened in the presence of the object, but the word is strengthened in the presence of the stimulus properties of the responses made to the ball as well. Since a portion of these responses constitute the meaning of the word _ball_, the stimulus properties of the meaning elicited by the word _ball_ come, in turn, to elicit the word _ball_ again.

The above analysis suggests that in order to postulate part-of-speech (e.g., "verb") habit families, it is necessary to assume that words comprising the same part of speech, at least in the early language training of the child, are consistently paired with distinctive aspects of the child's environment. It is proposed that verbs are learned in the presence of certain complex stimuli of _activity_ (either external or internal to the child). For example, when a spherical object is moving across the floor, the mother may say SEE THE BALL ROLL, SEE THE MARBLE ROLL, etc. In this manner, a portion of the total response made to a spherical object moving across a flat surface should, through classical conditioning, come to be elicited by the word _roll_. Further, the child would be reinforced for saying ROLL in the presence of such a stimulus, thus strengthening this verbal response both in the presence of the appropriate enviromental stimuli and in the presence of the total response made to these stimuli (including that portion constituting the meaning of the word roll). The process whereby the word roll comes to elicit a portion of the total response made to a rolling object, the stimulus properties of which, in turn, elicit the word roll, is depicted in Figure 4.

Although the responses made to various aspects of activity in one's environment would be expected to differ from each other in certain ways, they also would be expected to be similar to each other in certain ways. Thus, all words consistently paired with environmental activity would be expected both to elicit and be elicited by a common meaning component, to be called hereafter a "verb meaning response component." More generally, it is suggested that words belonging to the same form class share a common grammatical meaning, defined as an implicit response, and that this grammatical meaning helps to determine the form class properties of the words which elicit it.

One would expect that if verbs were words which elicited a portion of the total response made to environmental activity, then verbs should be responded to as more active than words having different part-of-speech membership. Livant (1963) had Ss rate a group of words which were ambiguous with respect to their grammatical class (i.e., they could be used as either verbs or nouns) on an active-passive semantic differential scale. The words were rated under two conditions: In one condition the words were embedded in sentence frames defining nouns, and in the other the words were placed in sentences defining

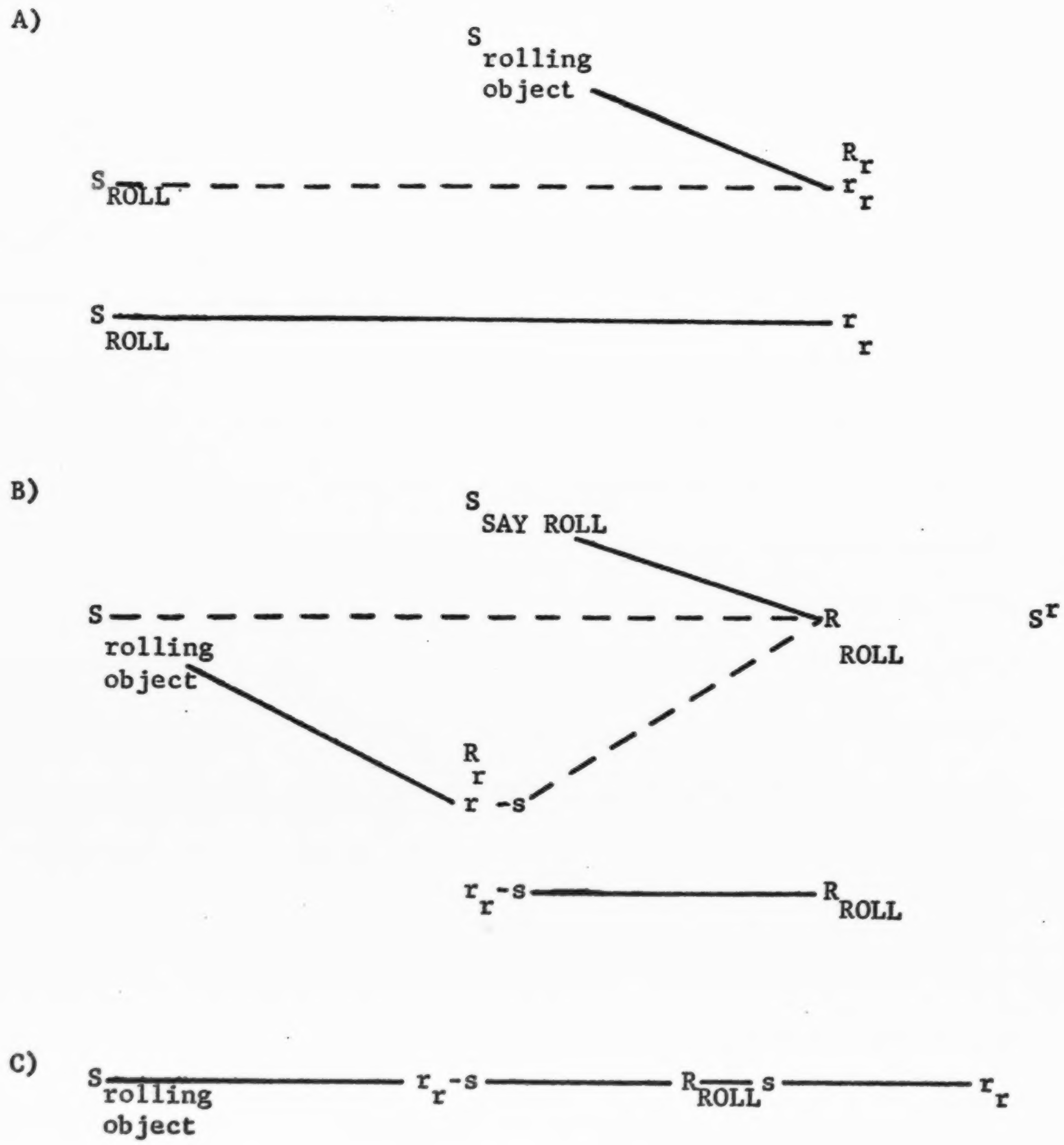
A)
S rolling object
R_r
S_{ROLL}
r_r
S_{ROLL}
r_r
B)
$S_{SAY\ ROLL}$
S rolling object
R ROLL
S^r
R_r
r_r-s
r_r-s
R_{ROLL}
C)
S rolling object
r_r-s
R_{ROLL}s
r_r

Figure 4. (A) Development of meaning of the word roll. When the stimulus of a rolling object is paired with the word ROLL, it elicits a sensory response (R_r) in the child, a portion of which (r_r) becomes conditioned to the word, constituting its meaning. (B) When the child, in response to his mother's prompting, says ROLL in the presence of the rolling object and is reinforced, both the stimulus of the rolling object and the stimulus properties of the detachable portion of the sensory response made to the rolling object come to elicit the word. (C) Thus, when the rolling object is presented, a sensory response is emitted, the stimulus properties of which elicit the word ROLL, which, in turn, elicits the meaning response. (Adapted from Staats, 1961.)

them as verbs. It was found that the same words were rated more active when used as verbs than when used as nouns.

If the present analysis is correct, it would be expected that a novel word would gain verb properties if it became a member of a verb habit family. Thus, if the novel word were paired with environmental stimuli of activity and if it were reinforced when emitted in the presence of these stimuli, the word should demonstrate verb properties. In investigating the interaction between syntactic and semantic components in new word learning Prentice (1966) exposed one group of Ss to a learning task in which the children learned to associate trigrams with a set of pictures. Each trigram was consistently paired with a given picture, and each picture represented a different grammatical form class (e.g., count nouns, mass nouns, intransitive verbs, etc.). With the exception of the picture representing an adverb, the grammatical concepts illustrated were devised to have no ready synonym in English. Following the completion of this task Ss were given a "grammatical usage test," composed of sentence-completion items. The Ss were required to place one of the trigrams into the blank in each sentence, the sentence's context defining the missing word with respect to part-of-speech membership. Even though Ss were never presented the trigrams in sentences, they performed at a better than chance level. Prentice suggested that this might be due to implicit verbal mediators or labelling responses, in spite of her attempt to control for this in the initial construction of the concept pictures. An alternative explanation is that a portion of the total response made to each picture was its grammatical meaning, which became conditioned to the nonsense word and thus mediated its placement in the appropriate sentence frame.

If a word can gain verb properties by being paired with certain stimuli which elicit a verb meaning response component on an unconditioned basis (first-order conditioning), then it seems possible that a word could also gain verb properties by being paired with stimuli which elicit such response components on a conditioned basis, e.g., other verbs.

The Nature of the Common Response Component: Words and Affixes. Although the verbal habit family mechanism is defined by Staats in terms of a common meaning response component, the mechanism should be operative with any common response substituted for the meaning response. It is suggested that two other types of responses operate in determining grammatical habit families. First, most children in this country have long educational histories in which they learn specific labels to words sharing a common part-of-speech membership; such labels could then serve as the basis for a grammatical habit family. For example, the word class of verbs should condition more rapidly using college student *S*s, since they already have learned the label "verb" to the word class, i.e., the word *verb* would have tendencies to elicit the various words in the class which, in turn, would have tendencies to elicit the word *verb* again.

A third type of mediating response is based upon some of the "distinctive features" identified by Fries (1952). A verb does not occur solely in the infinitive. Various grammatical considerations give rise to different forms of the verb, many of which consist of the infinitive with some suffix. For instance, the present participle of a verb consists of the infinitive form with the ending ING. Many verbs in the past tense (i.e., "regular" verbs) consist of the infinitive form with the ending ED.

If a group of words all elicited a common word ending (at least implicity) and in turn were all elicited by that word ending, a mechanism analogous to the verbal habit family would exist. For example, since the individual is often reinforced for emitting the infinitive form of a verb followed by the suffix ING, it would be expected that all verbs in the individual's repertoire would tend to elicit that response. Further, a great deal of a child's language training is echoic in nature; that is, the child is reinforced for emitting an auditory stimulus which matches that produced by another individual. Whenever the child is required to echo a verb in the present participle, he is reinforced for emitting the infinitive form of the verb in the presence of the suffix ING, and conversely, the child is reinforced for emitting ING in the presence of the infinitive. Many such trials with a number of different verbs would result in the suffix having a tendency to elicit a variety of different verbs. Thus, a habit family of verbs would exist on the basis of the common word ending ING. This process is diagrammed in Figure 5.

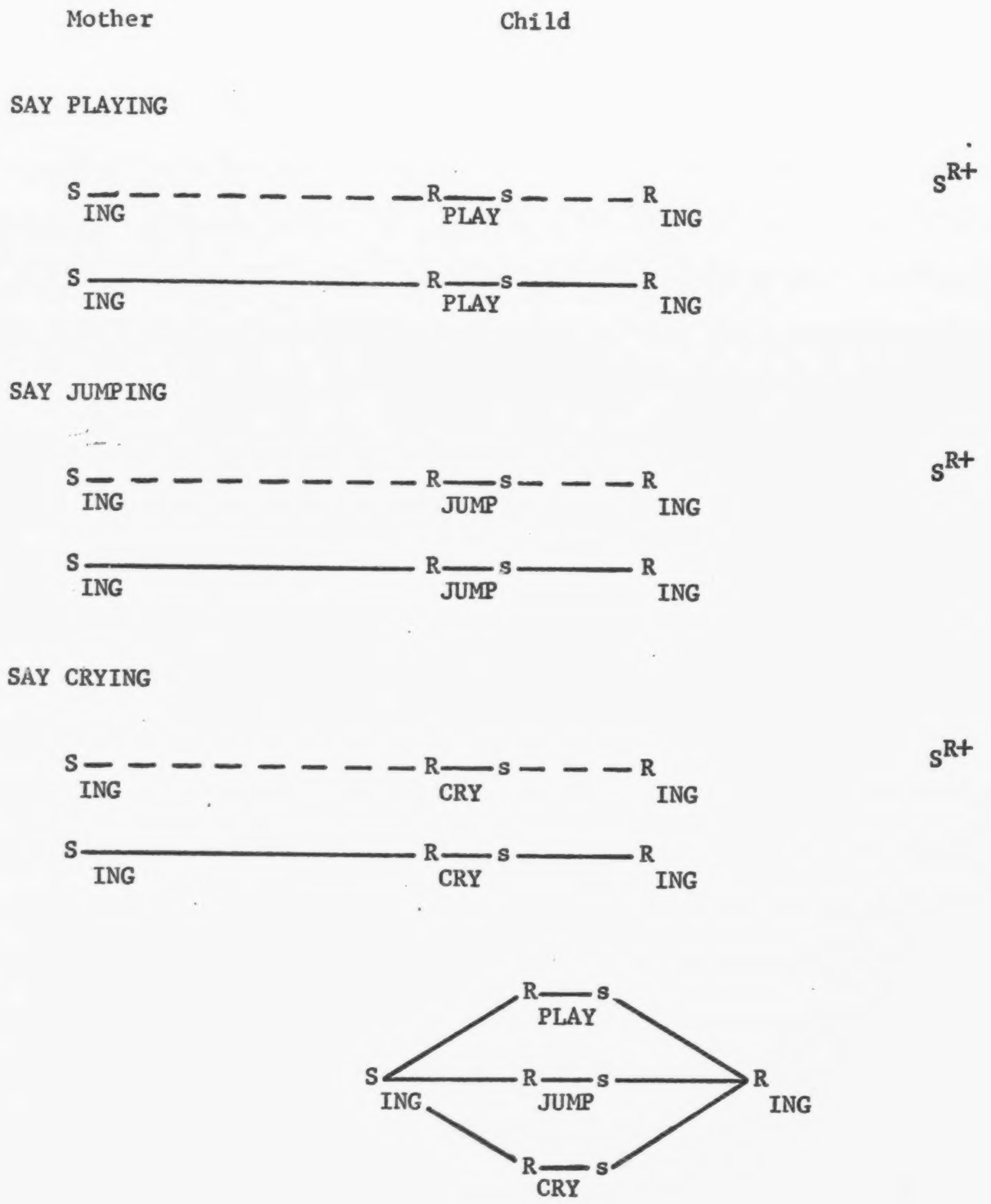
Mother
Child
SAY PLAYING
S ING
R PLAY
s
R ING
s^{R+}
S ING
R PLAY
s
R ING
SAY JUMPING
S ING
R JUMP
s
R ING
s^{R+}
S ING
R JUMP
s
R ING
SAY CRYING
S ING
R CRY
s
R ING
s^{R+}
S ING
R CRY
s
R ING
R PLAY s
S ING
R JUMP s
R ING
R CRY s

Figure 5. The "verb" habit family on the basis of a common affix. When the mother says SAY PLAYING and the child echoes PLAYING, the child is reinforced. This fulfills two functions: (1) it strengthens the tendency for the verb PLAY to elicit the word ending ING: and (2) it strengthens the tendency for the word ending ING to elicit the verb PLAY. A number of such trials with a variety of different verbs results in the formation of a habit family on the basis of the common verbal response ING. (Adapted from Staats and Staats, 1963.)

The Sentence as a Habit Family Chain.

Ervin-Tripp and Slobin (1966) suggested that one important task of a theory of linguistic behavior is accounting for novel speech production. It is suggested that the production of novel speech may be equated with what was termed "syntactic generalization" in the previous chapter. That is, novel speech is the use of previously learned words in new, albeit grammatical, contexts. The present analysis of form class membership suggests that the use of words in novel combinations may be a form of semantic generalization.

It is proposed that not just verbs are paired with distinctive aspects of the child's environment during his early language learning, but that the three other main form classes (nouns, adjectives, and adverbs) are as well. Further, words in different classes frequently have associated with them distinctive affixes. On these bases it would be expected that habit families would exist for each form class. If this is the case, it would be expected further that as language develops, grammatical habit families become associated in the child in certain sequences, corresponding to the various word orders allowable in the language. As the child repeats various sentences in his early language development, the meaning responses corresponding to the various parts of speech would themselves become strongly associated, insofar as specific form classes occur in a given order in the sentences. Experience with a number of different sentences having different word orders would result in the formation of a number of such meaning response sequences. An illustration of the formation of one such sequence is diagrammed in Figure 6.

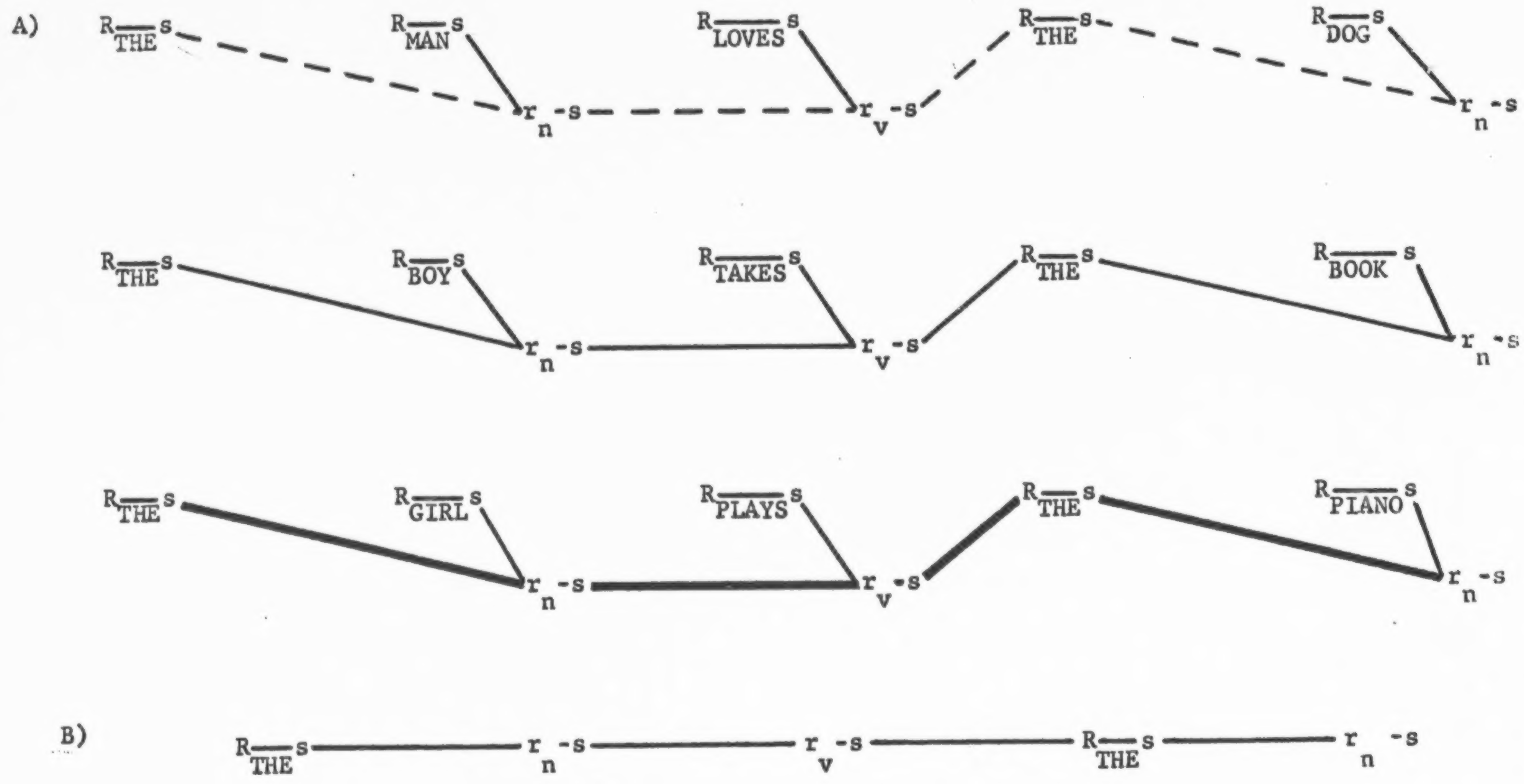
A)
R THE s
R MAN s
r n -s
R LOVES s
r v -s
R THE s
R DOG s
r n -s
R THE s
R BOY s
r n -s
R TAKES s
r v -s
R THE s
R BOOK s
r n -s
R THE s
R GIRL s
r n -s
R PLAYS s
r v -s
R THE s
R PIANO s
r n -s
B)
R THE s
r n -s
r v -s
R THE s
r n -s

Figure 6. The development of a meaning response sequence. (A) As the child repeats various sentences utilizing the same word order, the meaning responses corresponding to the various parts of speech become associated. (B) After a number of such trials, a meaning response sequence is formed.

Further, since each meaning response component is the basis for a habit family, these chains of meaning components can be envisioned as sequences of habit families, as diagrammed in Figure 7. Thus, once a new word had become a member of the verb habit family, no matter how such learning initially took place, it would be expected that the word could then occur in Position 3 in Figures 6 and 7, even though the word has never before been heard or used in that position.

Several aspects of this model of sentence generation need further clarification. First, it should be noted that a meaning response component has tendencies to elicit both another meaning response component and other words belonging to the same grammatical class. However, since the child is not reinforced for emitting several verbs in succession (except under special circumstances), it would be expected that the emission of one verb would then serve as an S^{Δ} for the emission of further verbs. Secondly, it will be noted in Figures 6 and 7 that no general meaning common to all function words is included in this analysis. Rather, each function word elicits the grammatical meaning appropriate to the response class which may follow it in the sentence. It is suggested that function words may serve as overt mediators in sentence generation, and that these need not have general class properties of their own, since they are paired consistently only with other words which may follow them in a sentence. Finally, it is recognized that the model outlined in this paper is greatly oversimplified. The role of direct associations among various words, the influence of environmental stimuli, and the influence of more traditional semantic cues have been omitted. This model is not

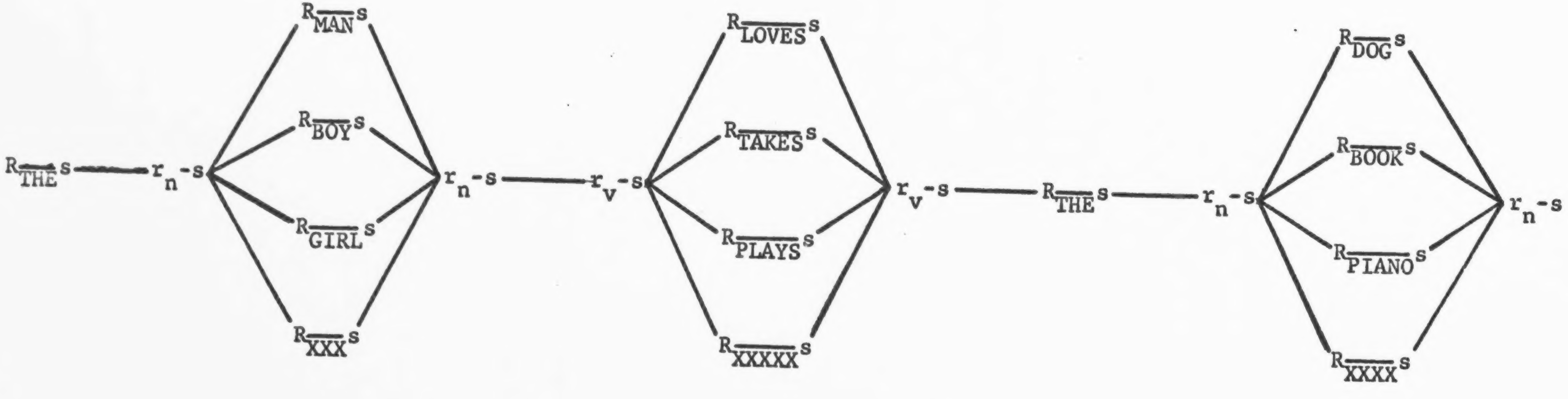
R THE s
r n -s
R MAN s
R BOY s
R GIRL s
R XXX s
r n -s
r v -s
R LOVES s
R TAKES s
R PLAYS s
R XXXXX s
r v -s
R THE s
r n -s
R DOG s
R BOOK s
R PIANO s
R XXXX s
r n -s

Figure 7. A grammatical habit-family sequence. Once a new word becomes a member of a given habit family, it may occur in a sentence utilizing this word order sequence, regardless of how that word became a member of that habit family. It should be noted that in actuality, MAN, BOY, GIRL, DOG, BOOK, and PIANO are all members of a common habit family, not two habit families as suggested by this diagram.

designed to be a substitute for various other S-R analyses of grammar, but rather an addition to them.

The model developed in this chapter suggests that there exist a number of ways in which a word may become a member of a grammatical habit family. It was suggested earlier that pairing the word with appropriate environmental stimuli or with other words of the same form class, and that presenting the word with appropriate affixes would result in the word acquiring part-of-speech properties by becoming a CS for the appropriate meaning response. Further, since it is hypothesized that function words usually have no general class properties of their own and that they elicit only the meaning response representing the grammatical class of the words which may follow them, it is proposed that preceding a word with allowable function words will also contribute to the word acquiring appropriate form class properties, in that the word will become conditioned to (and, through rehearsal, will come to elicit) the appropriate meaning response. Similarly, using the word as a given part of speech in sentences with other acceptable word orders should provide the same type of experience.

In other words, there exists a variety of experiences which will place a new word into an appropriate form class and allow that word to be used correctly in a variety of sentences. Perhaps the best example in the literature of syntactic generalization was an experiment by Brown and Berko (1960) who demonstrated how a child having several types of such experiences can use a novel word appropriately in new sentences. Brown and Berko illustrated the formation of various parts of speech out of a nonsense syllable using grammatical affixes, syntactical location in a sentence, and pictures. For example, the child would be shown a picture and told, "Do you know what a wug is? This is a picture of a little girl thinking about a wug. Can you make up what that might mean?" The child would then use the word wug in a novel sentence, such as "The man has some wugs for breakfast every day."

Evaluation of the Model

It is suggested that the above model must be evaulated on two basic points: (1) the degree to which it can explain the grammatical form class phenomena while reducing or eliminating the objections that have been raised against other such attempts, and (2) the degree to which it generates testable predictions. In Chapters II and III it was suggested that there were three phenomena which must be handled by a theory of the nature of grammatical form classes: syntactic generalization, the syntagmatic-paradigmatic shift, and the word class properties of such categories. Analyses based on this model of both syntactic generalization and the operant conditioning of form classes already have been presented in the present chapter.

An alternative explanation for the syntagmatic-paradigmatic shift phenomenon also is suggested by this conception of a grammatical habit family. As a child grows older, the pairings between any two specific words in normal speech would be expected to become less frequent in relation to the total number of such pairings that occur. Thus, the probability of deep being followed by hole is greater with the young child. However, as a child grows older and his vocabulary increases, *deep* would be expected to be followed by more and more different words, resulting in both less absolute strength between *deep* and *hole* and in greater interference from the other words learned in response to *deep*. However, the word *deep* consistently would elicit the meaning response component appropriate to adjectives, which thus could help mediate another adjective. Further, if the word shared other meaning components in common with other words in the same class, as do *deep* and *shallow*, this additional source of mediation would make the word *shallow* the most probable response in the situation.

The present analysis has specified an additional stimulus property of language (i.e., grammatical meaning), and described necessary types of learning experiences. Further, it has overcome one of the major criticisms of previous S-R analyses of sentence structure. While the complexities of adult language have strained earlier theoretical statements of language structure which have relied upon the development of word associations, because of the number of such associations required, the present analysis suggests that only one association is critical before a new word may be used correctly in sentences, i.e., the association between the word and the appropriate grammatical meaning response. Further, the reaction time problems of mediation theories utilizing word associations have been minimized. One mediator, assumed to have become as "reduced" as possible without losing its cue functions, has been substituted for implicitly evoked words and chains of words. Further, Osgood (1963) suggested that "representational mediating responses," or meaning responses, may operate on the cortical rather than the peripheral level, reducing still further the reaction time required by such responses.

Perhaps even more important than the degree to which a model may handle already known phenomena, however, is the degree to which it produces predictions amenable to experimental verification. In the next chapter, two such hypotheses generated by this model are tested in three experiments. The first two experiments are designed to directly test the hypothesis that verbs will operantly condition as a response class. The third experiment is a test of the hypothesis that nonsense words can gain verb properties through being paired with stimuli which elicit a verb meaning response component on a conditioned basis, i.e., other verbs, and that the grammatical properties so acquired are susceptible to one variable known to affect response strength in general, i.e., number of learning trials.

IV

EXPERIMENTAL EVALUATION

Experiment 1

Although several sources of evidence suggest that grammatical form classes should condition as word response classes (cf. Chapter III), no direct experimental demonstration has yet been made (Ervin-Tripp & Slobin, 1966). One reason that the word class properties of grammatical form classes have not yet been demonstrated would appear to be the lack of an appropriate experimental technique. The Taffel (1955) controlled operant technique depends upon Ss making sentences when subjects and predicates are supplied by the experimenter, and is thus inappropriate with respect to this experimental question. A major problem with the Greenspoon free operant technique was illustrated to the present writer in an informal pilot experiment designed to demonstrate the word class properties of verbs. Subjects merely were instructed to emit words, one at a time, with reinforcement administered each time a verb was presented. With this procedure, however, Ss tended to perseverate on sub-classes of verbs rather than to emit verbs in general. While verb emission did indeed increase in frequency under this procedure, the verbs were clustered into sub-classes, e.g., the S might emit a number of verbs dealing with locomotion, e.g., WALK, RUN, JUMP, etc., and then emit words from another grammatical class until a new sub-class of verbs would occur, e.g., verbs dealing with vocal speech, such as WHISPER, TALK, LAUGH, etc.

The following experiment utilized a procedure developed by Staats, Staats, Finley, and Minke (1961) which largely overcomes these problems. The experiment was designed to demonstrate that words belonging to the same grammatical form class, i.e., _verbs_, also will operate as a word response class in the operant sense. Further, an attempt was made to control for the possibility that a common label was mediating performance by using as _S_s children who supposedly had not yet been taught the grammatical concept "verb" in their formal education.

Method

Subjects. Twenty children were randomly selected from the six fourth grade homeroom classes in Evansville Elementary School, Evansville, Wisconsin. Ten _S_s were randomly designated as Experimental _S_s and ten as Control _S_s.

Materials. A list of the verbs occurring in the 1000 most common words in the English language (Thorndike and Lorge, 1944) was compiled. The requirement was made that the verbs listed has to be classified as belonging to one and only one part of speech according to the _Webster's Seventh New Collegiate Dictionary_ (1963).* Forty-seven verbs were so identified. From this list 30 verbs were randomly selected for use in this experiment. Sixty control words which were never used as verbs were randomly selected from the Thorndike-Lorge List. Each verb was matched with two control words with respect to frequency of occurrence (i.e., if the verb occurred in the first 500 words, the control words also were selected from the first 500 words; conversely, if the verb occurred in the second 500 words, the control words were selected from that portion of the list). The verbs and their respective control words are presented in Table 1.

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*Although the verbs utilized in this experiment were not identified as members of a common form class according to the operational definition of such classes, Brown and Berko (1960) point out that functional equivalence is a matter of degree, and that parts of speech may be regarded as "very large and very useful classes of approximate combinational equivalents" (p. 5).

Each verb and its control words were typed in a row, in random order, on a 5 x 8 index card in primary type. The thirty cards were then randomly grouped into five sets of six cards each. The presentation orders of the five sets were determined by the rows of a 5 x 5 Latin Square to ensure that each set would occur in all possible trial block positions. Two Experimental *S*s and two Control *S*s were exposed to each set order.

The cards were presented by mounting them one at a time on the front of a black partition which shielded *E* and his materials from *S*'s view. The experiment was conducted in an empty classroom where the procedure was administered to *S*s individually.

Procedure. *S*s were seated in front of the partition and given the following instructions:

> I am interested in how people choose different words when they are presented in different ways. Three words will be written on a card. You are to read all of the words to yourself and then say one of them out loud. This is all I can tell you, so unless you have any questions, we'll begin.

Experimental *S*s were given a pencil and paper for recording their scores and were read the following instructions in addition to those above:

> For saying one of the three words on the card--but not the other two--you will get a point. I will tell you

TABLE 1

Verbs and Respective Control Words
Used in Experiments 1 and 2

Set	Verb	Control Word 1	Control Word 2	Verb Position
	lose	west	ago	2
	allow	afraid	building*	3
I	bring	night	happy	2
	forget	health	truth	1
	hear	natural	ill	3
	decide	tall	pleasant	1
	discover	thick	animal	3
	become	two	hour	1
II	teach	however	beast	1
	eat	beautiful	upon	2
	choose	cloth	nine	3
	learn	family	more	2
	grow	alone	most	3
	speak	at	north	1
III	appear	real	path	3
	write	behind	one	1
	enjoy	evening	safe	2
	suffer	all	if	2
	receive	only	five	2
	come	red	good	1
IV	spend	both	above	3
	require	river	half	1
	arrive	almost	once	3
	ask	child	some	2
	understand	public	common	2
	prepare	everything	Christmas	3
V	happen	possible	manner	1
	continue	proud	enemy	3
	begin	sure	too	2
	seize	seven	sheep	1

---

*The non-verb properties of this word can certainly be questioned; the word was inadvertently included as a control word and its potential use as a verb was not noticed until after Experiments 1 and 2 had been completed.

> when you get a point by tapping the table, like this (TAP). You keep count of your points. I will want to know how many points you make, so make a mark as soon as you receive each point. Remember, choose one of the words and say it out loud. If you choose the right word, you will get a point. Try to earn as many points as possible.

The instructions concerning the reinforcement contingencies were not presented to Control Ss, and none of their responses were followed by the pencil tap.

The cards were then presented to S one at a time. For Experimental Ss the first block of cards served to establish an operant level, i.e., none of the first six responses were followed by reinforcement. Following the first block, however, Experimental Ss were reinforced by E tapping a pencil sharply on the corner of the table every time they selected a verb.

Following the experiment, each S was asked several questions designed to determine his degree of awareness of the nature of the words on each card and the reinforcement contingencies: (1) "Did you notice anything special about the words on the cards?" (2) "Why did you say aloud the particular words that you did?" (3) (Experimental Ss only) "How do you think you earned your points?" Further, two tasks were administered to determine the degree to which Ss were familiar with the concept "verb." Ss were first asked, "What is a verb?" Then they were presented with a card containing two sentences (All the cats met every morning and Bobby opened one eye) and were asked, "Can you show me the verb in each of the sentences on this card?"

Results

The mean number of verbs emitted in each block of six trials for

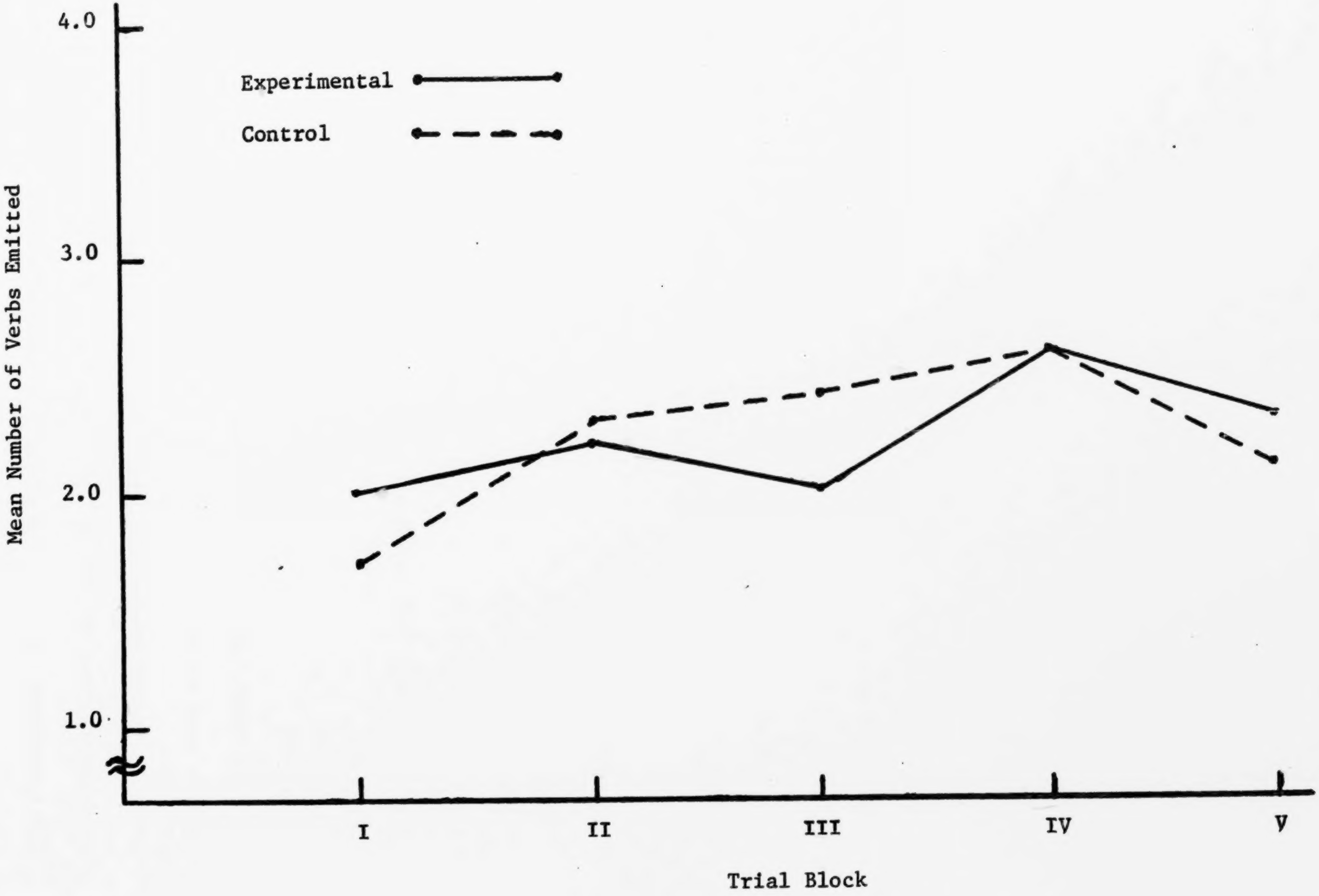

Figure 8. Mean number of verbs emitted in each block of six trials.

the two groups are presented in Figure 8. As can be seen, no differences are apparent between the two groups; however, the performance of both the Experimental and Control Groups seems to rise above chance level (i.e., 2 verbs per block) across trials. Nevertheless, neither an analysis of variance on the number of verbs emitted in each block nor a trend analysis on the trial block means (Edwards, 1960) yielded significant values. These analyses are summarized in Table 2.

A Latin Square analysis was performed on the number of verbs emitted in each block, utilizing the "same square replication design" outlined by Edwards (1960). This analysis, summarized in Table 3, demonstrated that no systematic effects could be attributed either to the various orders of word set presentation or to any of the particular sets themselves, indicating that the word sets were relatively homogeneous.

None of the Ss indicated any awareness of the reinforcement contingencies. Only ten of the twenty Ss indicated complete ignorance of the "verb" concept, however. Five Ss could both define a verb and indicate the verbs in the two sentences shown them, and five Ss could either define a verb or identify the verb in at least one of the two sentences.

Discussion

The hypothesis that a group of verbs could be demonstrated to exhibit word class properties was not supported. However, in retrospect, it seemed reasonable that this result might be a function of the experimental procedures rather than a true absence of the phenomenon. The reinforcer in this experiment was one whose reinforcing properties

TABLE 2

Summary of Analysis of Variance and Trend Analysis on Number of Verbs Emitted in Each Block

Source	df	x^2	s^2	F
Treatment	1	0.00	0.00	---
S(Treatment)	18	38.76	2.15	
Trials	4	5.66	1.42	---
Linear	1	2.21	2.21	1.48
Quadratic	1	1.89	1.89	1.27
Residual	2	1.56	0.78	---
Treatment x Trials	4	1.50	0.38	---
Linear	1	0.01	0.01	---
Quadratic	1	1.29	1.29	---
Residual	2	0.20	0.10	---
S(Treatment) x Trials	72	107.24	1.49	
Total	99	153.16		

TABLE 3

Summary of Latin Square Analysis on Word Sets

Source	*df*	x^2	s^2	*F*
Set Sequences	4	15.86	3.97	2.60
Error (a)	15	22.90	1.53	
Sets	4	12.46	3.12	2.33
Trial Blocks	4	5.66	1.42	1.06
Error (b)	72	96.28	1.34	
Total	99	153.16		

had been established only with a much different subject population, i.e., college undergraduates. Conceivably, differential performance may have been obtained with a more powerful reinforcer.

Experiment 2

Because of the above consideration, Experiment 1 was replicated, using a stronger reinforcer consisting of points plus social (verbal) reinforcement and utilizing younger children in an attempt to reduce the likelihood that the Ss would have been exposed to the concept of part-of-speech membership in their formal schooling.

Method

Subjects. Twenty children enrolled in Evansville Elementary School were randomly selected from the six second-grade homeroom classes and randomly assigned to either an Experimental Group (EXP_1) or a Control Group (CONT). One week later another ten Ss were selected from the same population as a second Experimental Group (EXP_2).

Materials. The experimental materials were the same as in Experiment 1. As before, the presentation order of the five 6-word sets was determined by the rows of a 5 x 5 Latin Square. The cards were presented by placing them one at a time on the table in front of S; E sat to the side of S within his view. The materials were hidden behind the partition used in the previous experiment.

Procedure. Ss were seated in front of the partition and the following instructions were read to them:

> I want to know how people choose different words when they are presented in different ways. Three words will be written on a card. You are to read all of the words to yourself and then say one of them out loud.

> Since you may not be able to read all of the words, I will point to each word once and read it to you. This is all I can tell you, so unless you have any questions, we'll begin.

The Ss in both experimental groups were given, in addition, the special instructions concerning the delivery of points used in Experiment 1.

The cards were presented to S one at a time. As each card was presented, E pointed to each word in turn with a pencil and pronounced it. If, when the first card was presented, S attempted to read out loud along with E or if S did not respond within approximately ten seconds, E would say, "I will read all of the words to you once, and then you say just one of them out loud."

No point or social reinforcement was administered to CONT group responses. Under the EXP_1 condition, the first six responses were never reinforced; after the first block, however, E reinforced S each time he emitted a verb by tapping the pencil on the corner of the table and saying such things as "That's very good!" "Hey! You got another point!" "That's right!", etc., in an enthusiastic tone of voice. The Ss in the EXP_2 condition were administered the same procedure, except that no operant level was obtained, i.e., verb emission was reinforced during the first block as well.

At the end of the experiment all Ss were asked the awareness questions and were presented with the tasks designed to determine their knowledge of the concept of "verb."

Results

The mean number of verbs emitted in each block of six trials for the three groups are depicted in Figure 9. The severe drop in performance at Block II for the EXP_1 group and the subsequent continued

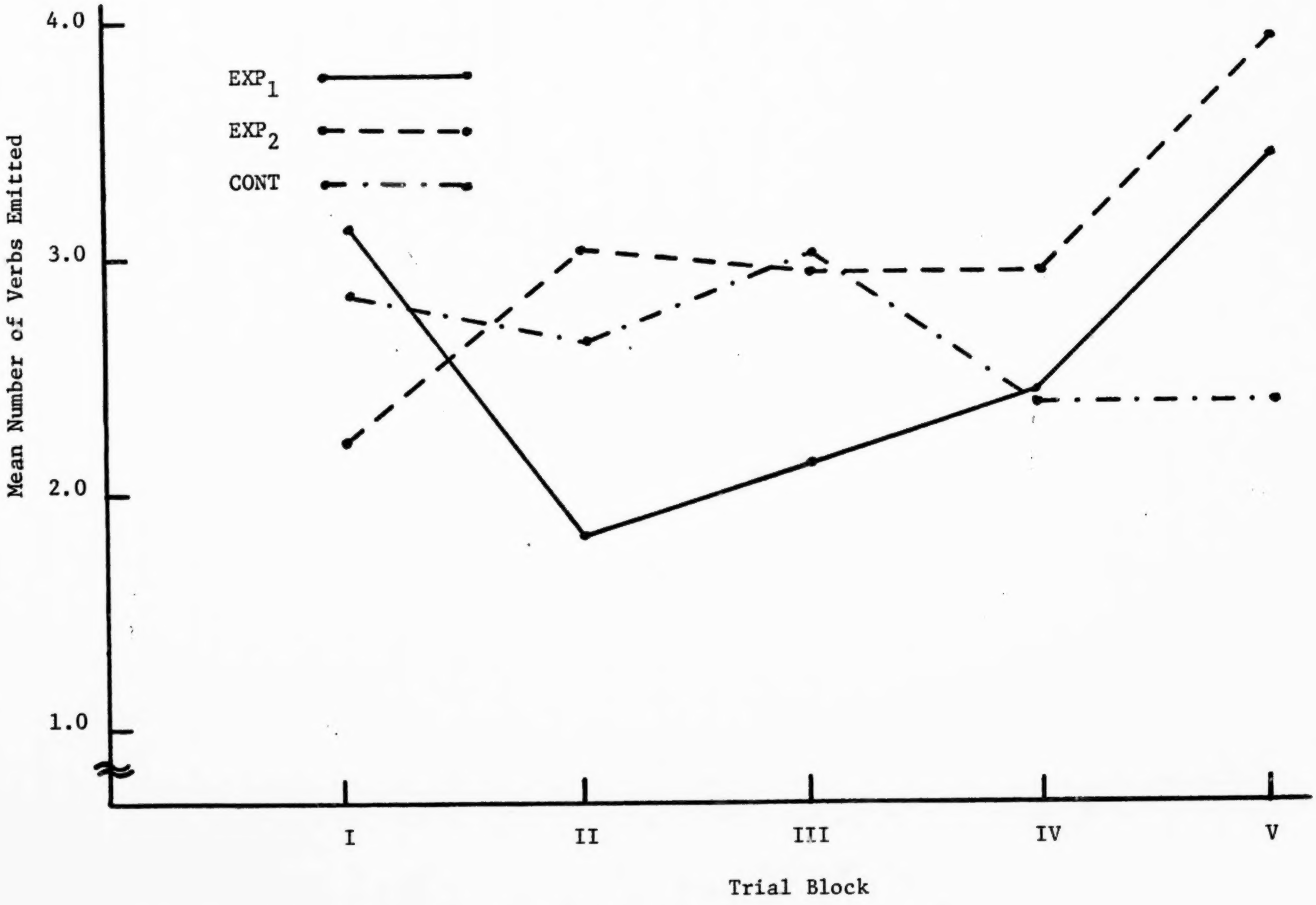

Figure 9. Mean number of verbs emitted in each block of six trials.

rise suggested that verb emission was being increased for Ss under the experimental condition, but that the effect was being masked by some variable operating in the early portion of the conditioning procedure. It seemed possible that not reinforcing any responses during the first six-trial block, in order to establish the operant level of emission of verbs, led to a suppression of verb responses in the second block. To determine if the operant procedure was influencing subsequent emission of verbs, condition EXP_2 was imposed. As can be seen, the result was a curve more closely approximating a traditional operant acquisition curve.

The results of an analysis of variance on the number of verbs emitted by Ss in the three groups across the five blocks of trials are summarized in Table 4. The significant Treatment x Trials interaction indicates that the curves of the three treatment conditions do not have the same form. A trend analysis showed that both the linear and the quadratic components of the curves for the separate treatment conditions differed significantly from one another. An inspection of the curves suggests that the significant difference in linearity among the three groups is mainly a function of the EXP_2 group, while the difference in curvature (quadratic component) is due mainly to the EXP_1 group.

A Latin Square analysis on the number of verbs emitted in each block of trials indicated that while the various sequences of word sets did not differ significantly from each other, a significant difference did exist among the particular sets themselves ($p < .01$; see Table 5). The five set means were subsequently analyzed by use of

TABLE 4

Summary of Analysis of Variance and Trend Analysis on Number of Verbs Emitted in Each Block

Source	df	x^2	s^2	F
Treatment	2	5.37	2.69	1.07
S(Treatment)	27	67.70	2.51	
Trials	4	9.97	2.49	1.69
Linear	1	3.41	3.41	2.32
Quadratic	1	4.61	4.61	3.14
Residual	2	1.95	0.98	----
Treatment x Trials	8	26.63	3.33	2.27*
Linear	2	10.61	5.31	3.61*
Quadratic	2	15.57	7.79	5.30**
Residual	4	0.45	0.11	----
S(Treatment) x Trials	108	159.00	1.47	
Total	149	268.67		

* $p < .05$
**$p < .01$

TABLE 5

Summary of Latin Square Analysis on Word Sets

Source	df	x^2	s^2	F
Set Sequences	4	5.24	1.31	---
Error (a)	25	67.83	2.71	
Sets	4	23.30	5.83	4.02**
Trial Blocks	4	9.97	2.49	1.72
Error (b)	112	162.33	1.45	
Total	149	268.67		

**$p < .01$

the Newman-Keuls Test, which indicated that Set I resulted in significantly fewer verbs being emitted than any other set except Set II ($p < .05$). None of the other sets differed significantly from each other. These results are summarized in Table 6.

None of the Ss at this grade level demonstrated any awareness of the response class being mainpulated or of the reinforcement contingencies. Further, none of the Ss showed any knowledge of the "verb" concept on either of the verb identification tasks.

Discussion

The hypothesis that words comprising a form class of verbs will also operantly condition as a response class, even though Ss have not yet learned the label "verb," was supported when the operant level procedure was omitted, i.e., in Treatment Condition EXP_2. Regarding the severe drop in verb emission from Block I to Block II under the EXP_1 condition, the following explanation seems plausible. The data from this experiment as well as from Experiment 1 suggests that Ss have a strong tendency to respond with verbs. Under the EXP_1 condition Ss were informed that points would be delivered, yet no points were administered for the first six trials, which means Ss were not reinforced for verb emission. Thus, the operant level period may have resulted in the extinction of verb responding and possibly in the eliciting of a variety of hypothesis-testing behaviors. As shown in Figure 9, the emission of verbs for EXP_2 Ss gradually recovered, presumably due to the systematic reinforcement of the partially extinguished verb responses.

Kanfer (1968) suggested that an appropriate procedure in word-class

TABLE 6

Summary of Newman-Keuls Test on Mean Number of Verbs Emitted in Each Word Set*

	Set				
	I	II	V	III	IV
Mean Number of Verbs Emitted	2.0	2.6	2.9	3.0	3.1
		———	———	———	———
		———	———	———	
		———	———		
	———	———			

---

*Any two set means not underscored by the same line are significantly different at the .05 level.

studies consists of "adapting out" irrelevant implicit behaviors by presenting a large number of unreinforced trials prior to the onset of experimental manipulation. Unfortunately, this was not possible with this age group because of the limited number of verbs in the first 1000 words which could be classified as belonging to one and only one part of speech. It was felt that to select verbs occurring less frequently in the language might well result in the inclusion of verbs not in _S_s' vocabulary.

The Latin Square analysis indicated that a significant source of variance in this experiment was the particular word sets employed. The Newman-Keuls Test suggested that the significant difference among the set means could be attributed to one deviant set, Set I. Although the differences among the set means were not significant in Experiment 1, Set I also resulted in the lowest emission of verbs when fourth grade _S_s were utilized. The reason for fewer verbs being selected from this set than from any of the other sets is not immediately clear. An examination of the particular verbs and control words employed in the experiment (Table 1, p. 49), however, indicates that this set contained the inappropriate control word _building_. Further, Set I is the only set that does not contain at least one function word as a control. Fortunately, the fact that one word set elicited significantly fewer verb responses than the other word sets does not affect the main conclusions reached, since each set occurred an equal number of times in each trial block for each treatment condition.

Experiment 3

One of the important consequences of the model developed in Chapter III is that it suggests a number of specific learning experiences which should result in a new word gaining part-of-speech membership. One of these experiences, discussed earlier, is the pairing of the novel word with other words of the form class in which the new word is to be included. It was proposed that such a procedure should result in the grammatical meaning component defining the form class both coming to elicit the new word and becoming conditioned to the stimulus properties of the word, thus including it in the appropriate grammatical habit family.

The following experiment was designed to test this hypothesis, as well as to demonstrate that grammatical properties so acquired are susceptible to one variable known to affect response strength in general, i.e., number of learning trials. Specifically, it was hypothesized that if the grammatical properties of a verb are mediated by a response common to all verbs, then pairing a nonsense syllable with a group of verbs should result in this response becoming conditioned to the nonsense syllable as well. The _S_s should then use this syllable as a verb in a grammatical usage test more frequently than a group of _S_s for whom all possible responses (three nonsense syllables) have been paired with verbs an equal number of times, or a group for whom the particular syllable has been consistently paired with non-verbs. Further, the strength of this tendency should be a function of the number of such pairings.

In addition, if the verb meaning component is a portion of the total response made to environmental activity, it is possible that the strength of this meaning response can be measured by use of a semantic differential scale. Thus, it would be predicted, first, that the verbs presented to Ss would be rated as more active than the non-verbs used in the experiment and, second, that the nonsense syllable paired with verbs would be rated increasingly more active the greater the number of pairings.

The procedure of the following experiment is adapted from that utilized by Staats and Staats (1959).

Method

Subjects. 126 Ss were randomly selected from the third and fourth grade homeroom classes in Evansville Elementary School, 63 Ss from each grade level. They were randomly assigned to one of nine groups, each group containing an equal number of third and fourth graders. Six of these groups contained 18 Ss each, and three contained six Ss each.

Materials. A list of 18 verbs and 36 non-verbs were randomly selected from the 1000 most common words in the English language in the manner described in Experiment 1. The 54 words were then grouped into three blocks of 18 words, each block containing 6 verbs and 12 non-verbs. The proportion of verbs occurring in the first 500 words in the Thorndike-Lorge list equaled the proportion of non-verbs from that portion of the list in each block. Word order within each block was random, with the restriction that no more than two verbs could occur in succession. Twenty-four additional non-verbs were selected: 18 for use in one of the control procedures, and six for use in a pre-training task. Five nonsense syllables (YOF, QUG, XEH, JIC, and GIW) were printed on slides so that they could be projected onto a large screen on the stage of the auditorium in which the experiment took place.

Three measuring instruments were used in the course of this experiment. A booklet was compiled containing 72 sets of three semantic differential scales for rating the 18 verbs and 54 non-verbs used in the conditioning phase (the six words used in the pre-training task were not rated). Each word was rated on the three scales, each scale representing a different connotative word meaning factor as identified by Osgood and Suci (1955): active-inactive, weak-strong, and pleasant-unpleasant. Words and scales were randomized, with twelve words, each followed by its appropriate scale, printed on a page. A sample portion of a booklet page is represented in Figure 10, which contains the example used in conjunction with the instructions to illustrate the use of the scales. The pages containing the scales were systematically rotated across booklets to control for possible warm-up and fatigue effects.

A grammatical usage test similar to that used by Prentice (1966) was constructed, consisting of 12 sentence frames printed on a single sheet of paper. Six of these frames defined verbs and two frames defined nouns, adjectives, and adverbs, respectively. A majority of these sentences were obtained from the Science Research Associates Reading Kit materials but were frequently modified to reduce the probability that any one specific word would usually be used to complete the sentence. The incomplete sentences were randomized on the page with respect to order with the exception that the first frame defined a

WHEAT

pleasant :_____:_____:_____:_____:_____:_____:_____: unpleasant

SICK

active :_____:_____:_____:_____:_____:_____:_____: inactive

TOMORROW

weak :_____:_____:_____:_____:_____:_____:_____: strong

Figure 10. Sample page of word rating booklet. This example was produced as a transparency and was used in conjunction with the instructions during the word rating session.

verb. The three nonsense syllables used in the conditioning procedure were typed at the top of the sheet. A copy of this test is presented in Figure 11.

The nonsense syllables YOF, QUG, and XEH, each followed by an active-inactive semantic differential scale, comprised the first three pages of a second booklet. Each word together with its scale was typed on a separate page, and the order of the pages was systematically rotated across booklets within each treatment group. The last three pages were designed to measure knowledge of the label "verb," and consisted of one page asking "What is a verb?" and two pages with the heading "Draw a line under the verbs in this sentence." On each of these last two pages there also appeared one of the sentences used during the post-experimental questioning in Experiments 1 and 2, i.e., All the cats met every morning, and Bobby opened one eye. Both this booklet and the grammatical usage test were placed in a sealed envelope which was handed to Ss as they arrived for the experimental session with the instructions that they were not to open the envelopes until instructed to do so.

In addition to the above materials, three transparencies for use on an overhead projector were prepared to accompany the instructions given to Ss during the various testing phases of the experiment.

Design. Three treatment conditions were used, with three groups under each treatment, each group being presented a different number of learning trials. One group under each condition was presented the first block of words; one group, the first and second blocks; and one group, all three blocks. In the Experimental Condition, the syllable YOF was consistently paired with verbs, while the syllables QUG and XEH

QUG YOF XEH

I never ________________.

There was ______________ all over the place.

It is the _______________ house.

"So I _______________ it too," she said.

We ___________________ some things.

They came _________________ into the room.

People _______________ other people most of the time.

Helen sat very _________________ on the grass.

"This is very _______________," the man said.

All the birds __________________.

Soon they began to _______________.

"Is my _______________ here?" Dick asked.

Figure 11. The grammatical usage test.

were paired an equal number of times with non-verbs. In the 0-Learning Trials Condition all three of the above syllables were paired with non-verbs, the 18 additional non-verbs being substituted for the verbs presented under the Experimental Condition. Each non-verb matched the verb it replaced with respect to Thorndike-Lorge frequency of occurrence. In the Control Condition each syllable was paired with two verbs and four non-verbs in each block of words. The three groups of Experimental Ss and the three groups of Control Ss each contained 18 Ss, while the three groups under the 0-Trials Condition contained six Ss each. This design is summarized in Table 7.

Procedure. Four days prior to the experiment proper, all 126 Ss were gathered in the auditorium and asked to rate the 72 words used in the experiment on semantic differential scales. The task was presented as a type of "language game," and E gave detailed instructions concerning the marking of the scales, using the example illustrated in Figure 10. (Complete instructions presented during this word rating session are in the Appendix.)

On the actual day of the experiment each group of Ss was seated in the auditorium and read the instructions below. Because of certain motivational problems encountered during the word rating session, the "language game" pretense was dropped.

> Today you are going to take part in a scientific experiment. I am trying to find out things about how people learn so that schools can teach children better. Thus, what you do here today is very important; the results of this experiment may well be written up in books used to train teachers. Because this is an experiment, it is important that you do just what I tell you and that you understand everything exactly.

TABLE 7

Summary of the Design of Experiment 3*

Condition	Syllables	Number of Word Blocks Presented 1	2	3
Experimental	YOF	6	12	18
	QUG	0	0	0
	XEH	0	0	0
		(n = 18)	(n = 18)	(n = 18)
0-Learning Trials	YOF	0	0	0
	QUG	0	0	0
	XEH	0	0	0
		(n = 6)	(n = 6)	(n = 6)
Control	YOF	2	4	6
	QUG	2	4	6
	XEH	2	4	6
		(n = 18)	(n = 18)	(n = 18)

*The numbers in each cell represent the total number of verb pairings with each of the three syllables; the number of Ss in each group is indicated in parentheses. In each group one half of the Ss were third graders and one half were from the fourth grade.

> This experiment is going to study two types of learning taking place at the same time. One type of learning deals with words being read to you and the other type deals with nonsense syllables that will appear on the screen. Now you probably don't know what a nonsense syllable is. A nonsense syllable looks like a word, but it doesn't occur in our language. I think you will see what I mean in a few minutes. After both types of words have been shown to you, you will be tested on the two types of learning, one at a time.
>
> The learning part of the experiment will be presented in the following way. A nonsense syllable will be shown on the screen. Then I will say a word out loud. You are to repeat the word out loud right after me while you keep looking at the nonsense syllable on the screen. As long as the nonsense syllable is on the screen keep looking at it, and after you have said the word out loud, keep repeating the word to yourself until the next slide is shown to you.
>
> Now this is important. The words and the syllables are to be learned in two different ways. The syllables on the screen will be shown more than once, and you are to learn them just by looking at them. Do not say the syllables out loud or to yourself. On the other hand, I will read many different words to you and they are to be learned by saying them out loud and to yourself. Do not make sentences out of the words. When a new word is read to you, concentrate only on that word. Do not try to remember any of the earlier words. After you have said the word out loud, keep repeating it to yourself while you look at the nonsense syllable on the screen. Keep repeating the word until the next slide comes on. Remember, learn the syllables only by looking at them, and learn the words by saying them out loud and to yourself.
>
> Do you have any questions? I will give you six words now just for practice, and then we will start the experiment.

At this point six trials were presented using two nonsense syllables (JIC and GIW) and six non-verbs, none of which were presented during the experiment proper. During this pretraining task E prompted Ss until they were repeating in unison the words presented. Further, E instructed any S who was not attending to the syllable on the screen that he was to "Look at the nonsense syllable and keep repeating the word to yourself." Following the completion of these six trials, any further questions that occurred were answered, and then the conditioning procedure was begun.

Each syllable was displayed for five seconds, with the exposure rate controlled by an automatic timer built into the slide projector. Approximately one second after the syllable was presented, E pronounced the word with which the syllable was paired. Under the Experimental Condition the syllable YOF was always paired with verbs, while QUG and XEH were always paired with non-verbs. Under the 0-Trials Condition the three groups were given the same instructions and were exposed to the same syllables and words as their respective Experimental Groups, except that new non-verbs were substituted for each verb in the original list. Under the Control Condition the syllables presented to the Experimental Groups were presented in the same order, but the words for each block were reassigned randomly with the restriction that each syllable occur with two verbs and four non-verbs. Regardless of the treatment condition, no word was presented more than once to any one S, i.e., on each presentation the nonsense syllable was paired with a different word. The actual syllable-word pairings used in the experiment are presented in Table 8.

After the conditioning phase of the experiment had been completed, Ss were instructed in the use of the grammatical usage test.

> Now I want to know how you feel about certain nonsense syllables. In a moment you will be given a sheet of paper with three nonsense syllables on it and a group

TABLE 8

Syllable-Word Pairings Under the Three Treatment Conditions

Block	Syllable	Experimental	O-Trials	Control
	GIW	big	big	big
	JIC	proud	proud	proud
Pre-Task	GIW	ago	ago	ago
	GIW	dead	dead	dead
	JIC	office	office	office
	JIC	girl	girl	girl
	YOF	destroy	farmer	all
	QUG	ocean	ocean	spend
	QUG	month	month	bless
	YOF	remember	when	ocean
	XEH	outside	outside	contain
	YOF	spend	neither	already
	QUG	nine	nine	golden
	XEH	within	within	path
I	YOF	bless	yesterday	remember
	XEH	once	once	outside
	XEH	path	path	soul
	YOF	contain	famous	month
	QUG	again	again	nine
	XEH	soul	soul	again
	XEH	already	already	become
	YOF	become	thing	destroy
	QUG	golden	golden	once
	QUG	all	all	within
	XEH	duty	duty	history
	XEH	week	week	both
	QUG	hair	hair	expect
	YOF	bring	town	yes
	XEH	brother	brother	suffer
	QUG	yes	yes	brother
	XEH	Indian	Indian	learn
	QUG	broad	broad	Indian
II	YOF	believe	he	duty
	QUG	both	both	hair
	XEH	during	during	few
	QUG	few	few	prove
	YOF	expect	middle	believe
	YOF	prove	everything	wife
	XEH	history	history	week
	YOF	suffer	ill	bring
	QUG	wife	wife	broad
	YOF	learn	only	during

TABLE 8 (Continued)

Block	Syllable	Experimental	O-Trials	Control
	XEH	because	because	such
	YOF	begin	much	indeed
	QUG	his	his	arrive
	YOF	eat	person	else
	YOF	attend	pleasant	loud
	XEH	easy	easy	happy
	QUG	else	else	attend
	XEH	happy	happy	member
III	XEH	perhaps	perhaps	require
	YOF	arrive	wonderful	eat
	QUG	woman	woman	perhaps
	QUG	such	such	about
	XEH	loud	loud	ask
	QUG	indeed	indeed	because
	YOF	ask	third	begin
	QUG	about	about	his
	YOF	require	nice	easy
	XEH	member	member	woman

> of sentences. Each sentence will have a word left out, like this (at this point the following display was projected onto the screen by means of the overhead projector):
>
> GIW LAJ JIC
>
> The __________ ran away.
>
> Your job will be to fill in each blank with one of the three syllables at the top of the page. For example, if you think the syllable G-I-W best fits in this sentence, then write that syllable here (E pointed to the blank). If you think L-A-J best fits, then write that in, and if you think J-I-C best fits, then write that in. On your paper there will be several sentences. For each sentence pick one of the three syllables at the top of the page. These syllables will be different from those on the screen. Do not use the three syllables on the screen; use only the three syllables on your paper. Use only those three syllables and write a syllable in every blank. For each sentence write in that syllable which you think best fits that sentence. Are there any questions? If there is a word that you cannot read, raise your hand and we will help you. When you have finished, raise your hand and we will check the paper for you. Now take the big sheet out of your envelope and fill in the blanks like I have told you.

The Ss then proceeded to complete the grammatical usage test. As each S raised his hand to indicate that he had finished the task, E or his assistant scanned the sheet to determine if S had used only the syllables printed on the sheet itself and if he had completed every sentence. When all Ss in the group indicated that they had finished, they were instructed to circle all of the syllables at the top of the page which they remembered being shown to them during the conditioning phase of the experiment.

Following the administration of the grammatical usage test, Ss were asked to rate the three nonsense syllables YOF, QUG, and XEH on the active-inactive semantic differential scale. The Ss were instructed again in the use of the semantic differential and, because it was apparent from the earlier word rating session that Ss had difficulty in using the semantic differential scales, a new example with key words printed above each space was projected throughout this portion of the testing phase. This example is included in the Appendix. Finally, Ss were instructed to answer the questions on the last three pages of their booklets which were designed to assess any knowledge of the meaning of the word "verb." Before Ss were dismissed, their booklets were checked to insure that all three scales had been rated and that only one mark had been made on each scale.

Results

It was apparent during the word rating session that many Ss did not understand the use of the semantic differential scales. Some Ss scored the words in such a way as to create symmetrical patterns down the pages, some gave multiple ratings to each word, and a few performed the task so slowly that they were not yet half finished by the time a majority of the Ss already had returned to their classrooms. Assuming that these Ss were aberrant in marking the scales or inordinately slow because of incomplete understanding of the task, their ratings were omitted from the analysis. Of the 126 Ss present during the word rating session, data from 87 were used to determine the mean semantic differential ratings. Mean ratings of the 72 words on the three connotative meaning scales are presented in the Appendix.

It was hypothesized that verbs would be rated as significantly more active than non-verbs on the active-inactive scale. Averaging the mean ratings for verbs and non-verbs on this scale, however, resulted in a slightly more active rating for the non-verbs than for the verbs. The average verb rating was 3.26 on the seven-point scale while the average non-verb rating was 3.19 (a rating of one indicated *extremely active*, while a rating of seven indicated *extremely inactive*). A t-test of the difference between these two means indicated that the two classes of words did not differ significantly on this measure ($t = 0.53$, $p > .50$).

In scoring the grammatical usage test, *S*s were given one point each time they used YOF in a sentence frame defining a verb and one point for each use of QUG or XEH in a frame defining a noun, adjective, or adverb. Thus, the maximum score on this test was 12, and chance score was 6. The mean scores on this instrument for the various groups and treatment conditions are presented in Table 9, and the analysis of variance on these scores is summarized in Table 10. None of the mean differences were significant. One *S* became emotionally upset during the testing phase of the experimental session and was dismissed before he had completed the grammatical usage test. In all analyses to be reported the mean scores of the remaining 8 *S*s in his treatment group (Experimental Condition, three word blocks presented) were substituted for his missing score.

Of considerable interest in this experiment was the effect of the number of conditioning trials upon grammatical usage test scores. It had been predicted that the greater the number of times YOF was paired with verbs, the greater the probability that YOF subsequently would be used as a verb in the sentence completion task. The score on this test, rather than increasing with increasing number of conditioning trials, *decreased* as a function of the number of pairings of

TABLE 9

Mean Scores on the Grammatical Usage Test

		Number of Word Blocks Presented			
Condition	Grade Level	1	2	3	Combined
	3	7.33	6.56	6.00	6.63
Experimental	4	6.67	6.22	5.71	6.20
	Combined	7.00	6.39	5.85	6.41
	3	6.00	9.00	6.33	7.11
0-Learning Trials	4	7.33	7.67	7.67	7.56
	Combined	6.67	8.33	7.00	7.33
	3	6.78	7.11	6.22	6.70
Control	4	6.44	5.56	7.22	6.41
	Combined	6.61	6.33	6.72	6.56
	Combined	6.79	6.64	6.39	6.61

TABLE 10

Summary of Analysis of Variance on Grammatical Usage Test Scores

Source	df	x^2	s^2	F
Treatment	2	11.64	5.82	1.83
Grade	1	1.94	1.94	----
Trials	2	3.38	1.69	----
Treatment x Grade	2	2.64	1.32	----
Treatment x Trials	4	19.24	4.81	1.51
Grade x Trails	2	11.72	5.86	1.84
Treatment x Grade x Trials	4	10.47	2.62	----
S(Groups)	108	343.82	3.18	
Total	125	404.85		

YOF with verbs (Figure 12). A trend analysis, summarized in Table 11, indicated that the linear component of the trend was significant ($p < .01$), and that the slope did not differ significantly between 3rd and 4th graders. (In this analysis the error term from the analysis based upon scores from all three Treatment Conditions was used as the best estimate of the error variance.)

In analyzing the active-inactive semantic differential ratings of the nonsense syllable YOF, two adjustments to the raw ratings were made. First, the mean rating of QUG and XEH was subtracted from the rating of YOF for each S. This was done to control for individual differences in the use of the semantic differential. Second, a constant of 7 was added to each score thus obtained to convert all scores to positive numbers. The mean adjusted scores on the syllable YOF for the various groups and Treatment Conditions are presented in Table 12. Neither an analysis of variance on these scores nor a trend analysis (performed on the pooled ratings for Ss under the 0-Trials Condition along with the three experimental groups) indicated any significant differences. These analyses are summarized in Tables 13 and 14, respectively.

Of the 62 fourth grade Ss, 19 could either define a "verb" or select the verb in at least one of the two sentences, 13 more could perform both tasks correctly, while 30 displayed no knowledge of the "verb" concept. None of the third grade Ss indicated any knowledge of the word "verb"

Discussion

Perhaps of greatest interest was the unexpected finding that the

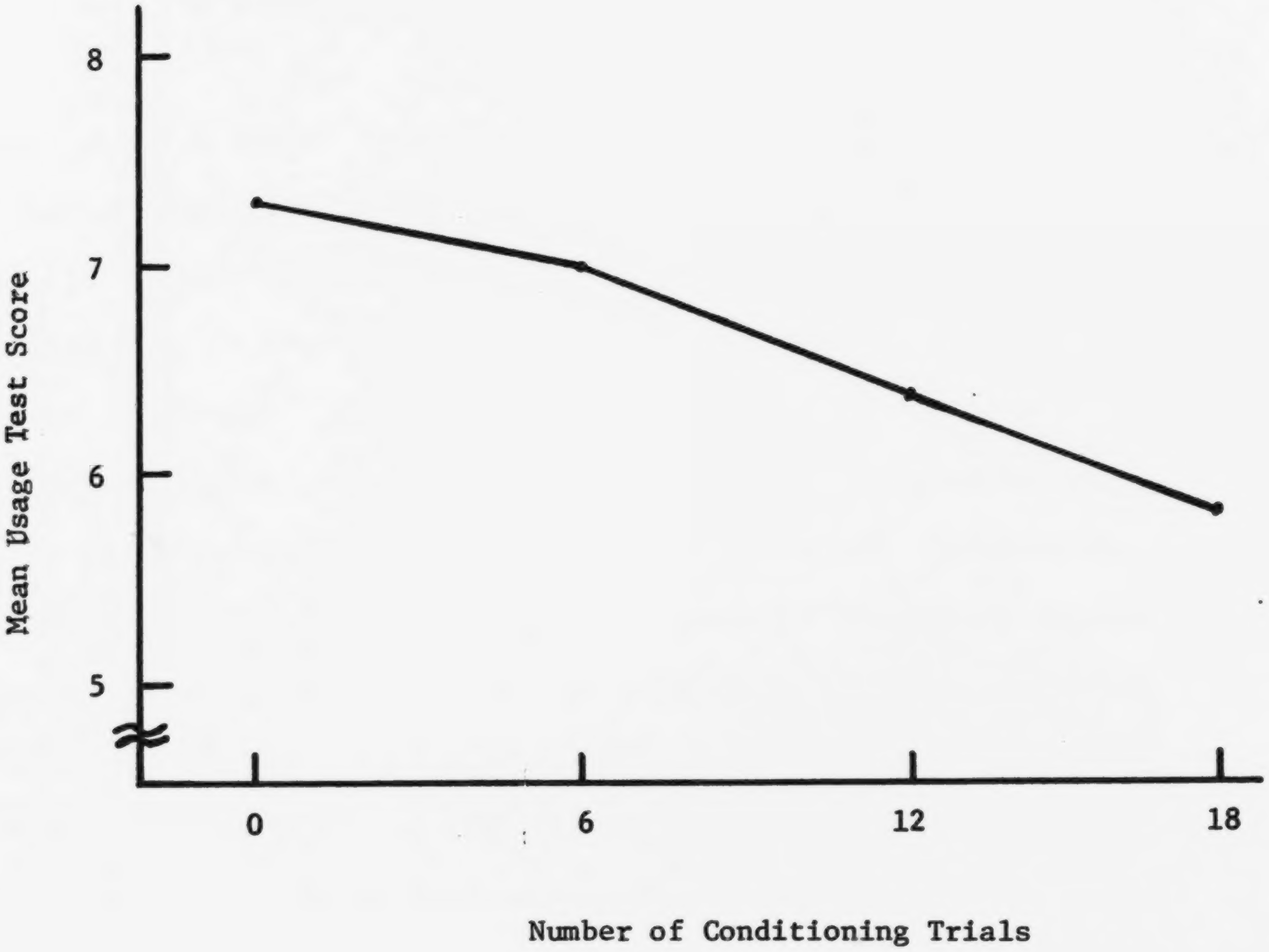

Figure 12. Mean grammatical usage test scores as a function of the number of pairings of YOF with verbs. The 18 Ss in each of the three groups in the Experimental Condition were exposed to 6, 12, or 18 conditioning trials, while YOF was never paired with verbs for the 18 Ss in the 0-Trials Condition. Therefore, the scores for the three 0-Learning Trials groups were pooled to produce the 0-Conditioning Trials data point.

TABLE 11

Trend Analysis on Grammatical Usage Test Scores as a Function of Number of Conditioning Trials

Source	df	x^2	s^2	F
Linear Trend				
Over-all	1	22.94	22.94	7.21**
Grade x Trials	1	0.79	0.79	----
Quadratic Trend				
Over-all	1	0.18	0.18	----
Grade x Trials	1	1.50	1.50	----
S(Groups)	108	343.82	3.18	

** $p < .01$

TABLE 12

Mean Adjusted Semantic Differential Scores for the Syllable YOF*

Condition	Grade Level	Number of Word Blocks Presented 1	2	3	Combined
	3	7.61	5.72	8.22	7.19
Experimental	4	7.78	7.22	6.62	7.21
	Combined	7.69	6.47	7.42	7.20
	3	7.50	7.83	5.50	6.94
0-Learning Trials	4	5.50	8.50	8.17	7.39
	Combined	6.50	8.17	6.83	7.17
	3	6.78	5.50	7.67	6.65
Control	4	5.50	6.22	7.00	6.24
	Combined	6.14	5.86	7.33	6.44
	Combined	6.86	6.45	7.30	6.87

*Lower scores indicate ratings closer to the active end of the active-inactive continuum.

TABLE 13

Summary of Analysis of Variance on Adjusted Semantic Differential Ratings

Source	df	x^2	s^2	F
Treatment	2	17.11	8.56	1.69
Grade	1	0.33	0.33	----
Trials	2	15.10	7.55	1.49
Treatment x Grade	2	2.81	1.41	----
Treatment x Trials	4	31.09	7.77	1.54
Grade x Trials	2	20.96	10.48	2.07
Treatment x Grade x Trials	4	26.71	6.68	1.32
S(Groups)	108	546.43	5.06	
Total	125	660.53		

TABLE 14

Trend Analysis on Adjusted Semantic Differential Ratings as a Function of Number of Conditioning Trials

Source	df	x^2	s^2	F
Linear Trend				
Over-all	1	0.19	0.19	----
Grade x Trials	1	5.18	5.18	1.02
Quadratic Trend				
Over-all	1	0.80	0.80	----
Grade x Trials	1	8.96	8.96	1.77
S(Groups)	108	546.43	5.06	

greater the number of pairings of the nonsense syllable YOF with verbs, the less frequently YOF was used as a verb in the grammatical usage test. The implications of this clear-cut effect with respect to theories of form class membership will be discussed in the next chapter.

None of the data collected by means of an active-inactive semantic differential scale demonstrated orderly relationships with respect to the experimental variables. There exist several possible reasons for this. For example, Ss at this age level may not have understood the scaling procedure, they may not have understood the terms "active" and "inactive", or possibly they did not understand the concept of rating words on a continuum. The problems encountered during the word rating session suggest that the latter may have been the case. However, during the testing phase of the experimental session, when the instructions were administered a second time, and when an example with the key word written above each space was projected continually during the rating, the aberrant ratings disappeared. Only one S was observed to make multiple marks on his scales during this second rating session. A simple repetition of the instructions with this subject quickly resulted in appropriate marking behavior.

Another possible reason for the failure of the rating data to show any consistent effects, of course, is that differences between verbs and non-verbs are not reflected on such scales. Although Livant (1963) did obtain differences on active-passive scales between verbs and non-verbs, he required Ss to rate the same words used as both parts of speech, thus eliminating variability due to word differences. Further, as Livant himself points out, his procedure required Ss to rate both noun and verb forms on the same scale before proceeding to the next word and scale. This "forced comparison" technique probably accentuated the differences between the two form classes and increased the probability that Ss could label the differences between the words in the two sentences. It should be noted further that college students served as Ss in Livant's experiment.

V

GENERAL DISCUSSION

A review of current theories pertaining to grammatical form classes suggests that while S-R analyses seem best able to handle both syntactic generalization and the syntagmatic-paradigmatic shift phenomenon, certain conceptual problems still exist. Particularly, as described in Chapter II, an adequate S-R analysis must minimize the number of associations that theoretically are required before a new word can be used correctly in a sentence. Further, it must overcome the "reaction time" criticism of S-R models of sentence generation.

In addition to explaining syntagmatic generalization and the syntagmatic-paradigmatic shift, the writer suggested that an S-R analysis of grammatical form classes must account for word-class properties of these form classes, in the operant sense. In Chapter III, based on several sources of evidence indicating that members of a common grammatical form class will operantly condition as a response class, part-of-speech membership was analyzed utilizing certain mechanisms which have been proposed by others to explain word class phenomena. Specifically, the writer developed a theoretical model of form classes which suggests that words sharing common part-of-speech membership are members of a common habit family, capable of both eliciting and being elicited by a common implicit response. It was suggested further that this implicit response might be a common word or label (e.g., the word "verb"), a common affix, or some common "grammatical meaning response." An implication of the model is that sentences may be regarded as sequences of grammatical habit families.

The hypothesis that words comprising a common part of speech also will condition as a response class was directly tested in Experiments 1 and 2. In spite of methodological difficulties, the model received some empirical support.

Experiment 3 tested another derivation of the model: the hypothesis that a novel word can gain verb properties by repeatedly being paired with verbs, thus conditioning the common grammatical meaning to the new word. While this hypothesis was not supported, the results seemed to indicate that part-of-speech membership involves some response process which is conditionable. That is, the greater the number of trials in which the nonsense syllable YOF was paired with verbs, the less often YOF was used as a verb (and the more frequently QUG and XEH were used as verbs). While the results of Experiment 3 did not confirm the hypothesis that verbs elicit a common grammatical meaning component, an ad hoc analysis suggests that the relationship between number of conditioning trials and form-class membership is not completely incompatible with the model developed in Chapter III. From the model of the sentence presented in Figures 6 and 7 (pp. 39 & 41), one would predict that verbs not only elicit the verb meaning component, but that verbs should come to elicit the meaning components defining parts of speech which may allowably follow verbs as well, mediated by the verb meaning response. Further, after a verb had been used in a number of sentences, it should come to elicit various non-verb meaning components directly. Thus, it would be possible for YOF to come to elicit a non-verb meaning response and be elicited by it. However, for such an explanation to be satisfactory, it is still necessary to explain the prepotence of the non-verb over the verb meaning component in the experimental situation.

The writer does not pretend that the current data clearly and completely validate his model to the exclusion of alternative associative or cognitive theories of grammatical behavior. At the same time, however, some of the present research certainly is consistent with predictions from the model, especially Experiment 2. In addition, the present research does demonstrate an important contribution of model building to scientific research. Models in general serve to suggest new ways of viewing and explaining particular phenomena and often suggest new variables which may influence these phenomena. To the extent that the present experiments have resulted in orderly data, the current model perhaps has served a useful function. Hopefully, future research will serve the dual function of providing better support for the model and suggesting still further extensions and implications of the model.

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APPENDIX

Instructions Presented During Word Rating Session, Experiment 3

As some of you may know, I have been playing various types of language games with some of your classmates. Today we are going to play another game dealing with language. Most of you will come back for yet another game sometime next week.

Today I want to find out how you feel about different words. People find they feel differently about different words, that is, the words have different meanings along certain lines. They find that some words give them a feeling of pleasantness, while others give them an unpleasant feeling. Some words seem active, while others seem inactive. Some words seem weak, some seem strong.

In front of you is a booklet. On each page there will be a group of words, with a scale for each word, like this. (At this point the sample scales depicted in Figure 10, p. 67 were projected on the screen.) Some of these scales will say pleasant and unpleasant, some will say active and inactive, and some will say weak and strong.

First look at the word and then mark on the scale how it strikes you. For example, the first word on this slide is WHEAT and the scale is a pleasant-unpleasant one. If the word WHEAT seems very pleasant, put an X here; if WHEAT seems quite pleasant, but not very pleasant, put an X here; if WHEAT seems a little pleasant, put an X here. If WHEAT seems neither pleasant nor unpleasant to you, then put an X here. On the other hand, if WHEAT seems a little unpleasant, then put your X here; if WHEAT seems quite unpleasant, put your X here, and if WHEAT seems very unpleasant, then put your X here.

The next word is SICK, and the scale says active-inactive. How many of you know what inactive means? Inactive means not active. You mark this scale in the same way. (The rating procedure was again explained in step-by-step fashion.)

The last word on the screen is TOMORROW. TOMORROW is to be rated as to whether it seems weak or strong. (The rating of TOMORROW on the weak-strong scale was illustrated.)

Now, before you begin, are there any questions? Remember to rate each word. If there are any words you can't read, raise your hand and someone will help you. You may begin now.

Sample Scale Used During Syllable Rating Task, Experiment 3

very very active	quite active	a little active	neither active nor inactive	a little inactive	quite inactive	very very inactive

GIW

active _________:_________:_________:_________:_________:_________:_________: inactive

Mean Semantic Ratings of Words Utilized in Experiment 3*

Word	P-U	A-I	W-S
about	3.29	3.47	3.76
again	3.08	3.17	4.25
all	2.91	3.23	4.40
already	3.13	3.46	4.19
arrive	2.94	2.72	4.28
ask	3.30	2.74	3.84
attend	2.74	3.34	4.07
because	3.92	3.47	3.87
become	2.95	3.40	3.86
begin	3.27	3.38	4.01
believe	3.11	3.09	4.66
bless	2.78	3.11	4.51
both	2.72	3.25	4.56
being	2.85	3.25	4.37
broad	4.20	4.04	4.04
brother	2.75	2.85	5.00

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*The mean ratings are given on three scales: pleasant-unpleasant (P-U), active-inactive (A-I), and weak-strong (W-S). A score of 1 indicates extremely _pleasant_, _active_, or _weak_ ratings, while a score of 7 indicates extremely _unpleasant_, _inactive_, or _strong_ ratings.

Word	P-U	A-I	W-S
contain	3.31	3.56	4.00
destroy	5.34	3.94	3.08
during	3.59	3.06	3.88
duty	3.54	3.23	4.02
easy	2.73	3.56	4.49
else	3.76	3.81	3.88
everything	3.05	3.34	4.45
expect	2.98	3.30	3.53
eat	2.70	2.71	5.18
famous	2.30	2.60	5.26
farmer	3.26	2.92	4.91
few	3.77	4.13	3.18
golden	2.81	2.23	4.74
hair	3.14	2.59	4.37
happy	2.00	2.45	4.14
he	3.22	2.73	4.58
his	3.34	3.38	4.19
history	3.21	2.95	4.65
ill	5.19	4.80	3.06
indeed	2.94	3.32	4.56
Indian	3.70	3.15	4.91
learn	2.78	2.79	4.84
loud	5.07	3.67	4.55
member	2.81	3.05	4.27

Word	P-U	A-I	W-S
middle	3.45	3.62	3.62
month	3.27	3.22	4.27
much	2.99	3.31	4.37
neither	4.17	3.98	3.33
nice	2.25	2.87	4.81
nine	2.85	3.49	4.14
ocean	3.20	2.72	4.83
once	3.40	3.23	3.62
only	4.19	3.45	3.80
outside	2.39	2.35	4.66
path	3.05	2.52	4.35
perhaps	3.19	3.36	4.05
person	3.06	2.57	4.64
pleasant	2.56	3.15	4.80
prove	2.94	3.15	4.76
remember	2.80	3.09	4.56
require	3.41	3.21	3.84
soul	3.30	3.10	4.51
spend	3.13	3.07	4.36
such	2.77	3.23	3.23
suffer	5.16	4.87	2.82
thing	3.27	3.42	3.98

Word	P-U	A-I	W-S
third	3.44	3.51	3.72
town	2.79	2.85	4.68
week	3.23	3.22	4.22
when	3.31	3.49	3.82
wife	2.94	2.56	4.46
within	3.48	3.29	4.12
woman	3.00	3.20	4.18
wonderful	2.13	2.30	4.86
yes	2.51	2.47	5.06
yesterday	3.20	3.84	3.88